

PHYSICS ABSTRACTS

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of
SCIENCE ABSTRACTS

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SECTION B, ELECTRICAL ENGINEERING

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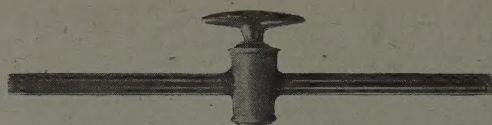
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061.3

774

Report of National Research Council Conference of Physicists. *Rev. Sci. Instrum.*, 15, pp. 283-328, Nov., 1944.—The conference, held in Philadelphia, May 19, dealt with the following subjects: Physics in education; Physics in industry; Professional standards in physics; Organization of physicists; Physics and government; Physics and its public relations.

511.6

775

First proof that the Mersenne number M_{157} is composite. UHLER, H. S. *Proc. Nat. Acad. Sci., Wash.*, 30, pp. 314-316, Oct., 1944.—The Mersenne number M_p is $2^p - 1$ where p is prime. M_{157} is shown to be composite, using the well-known theorem of Lucas.

L. S. G.

512.25 : 512.831

776

Some devices for the solution of large sets of simultaneous linear equations. (With an appendix on the reciprocation of partitioned matrices.) DUNCAN, W. J. *Phil. Mag.*, 35, pp. 660-670, Oct., 1944.—A method is described which is useful when facilities exist for solving a certain limited number of equations and it is required to solve a more numerous set. A matrix notation is used. If the equations are

$$\begin{pmatrix} A & B \\ C & D \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} g \\ h \end{pmatrix}$$

we have, using the first set, $Ax + By = g$, the result

$$x = A^{-1}g - A^{-1}By \quad (1)$$

so that the second set, $Cx + Dy = h$ becomes

$$Ey = h - CA^{-1}g \quad (2)$$

where $E \equiv D - CA^{-1}B$. The matrix equation (2) is solved for y and then the equation (1) for x . The details of the process of computation are given (together with numerical examples) and there is a discussion of methods for reciprocating matrices and partitioned matrices [See Abstr. 772 (1944)].

L. S. G.

512.31

777

Theory of algebraic functions based on the use of cycles. BEATTY, S., AND WALES, M. *Trans. Roy. Soc., Can.*, 38, Sect. III, pp. 11-30, May, 1944.—The theory is developed by making use of the cycles rather than the branches at a point $z = a$. Only integral powers of the element $(z - a)$ appear in a cycle. A process is outlined for obtaining the cycles at a point.

L. S. G.

512.831 : 512.25 see Abstr. 776

512.972 : 537.12 : 530.12 see Abstr. 840, 841

513.733

778

The invariants of webs of curves in R_n . CHOUDHURY, A. C. *Bull. Calcutta Math. Soc.*, 36, pp. 62-74, June, 1944.—The invariants are calculated and these generalize earlier results, due to Blaschke, relating to the invariants of a 3-web and of a 4-web of curves in R_3 .

L. S. G.

513.761.6 : 519.4 see Abstr. 792

513.83

779

Integral formulae for the characteristic classes of sphere bundles. CHERN, S. S. *Proc. Nat. Acad. Sci., Wash.*, 30, pp. 269-273, Sept., 1944.—In the theory

of sphere bundles there arises, in the base space, a class of topological invariants which can be regarded as generalizations of the Euler-Poincaré characteristic. By assuming the base space to be a differentiable manifold with a Riemannian metric, these invariants are expressed as integrals of certain differential invariants of the Riemannian manifold.

L. S. G.

517.37

780

A note on a certain multiple integral. GLADWIN, A. S. *Phil. Mag.*, 35, pp. 657-660, Oct., 1944.—Let

$$I_n(x, y) = \int_x^y f(u_1) du_1 \int_{u_1}^y f(u_2) du_2 \dots \int_{u_{n-1}}^y f(u_n) du_n.$$

It is proved that $I_n(x, y) = \{I_1(x, y)\}^n/n!$ where

$$I_1(x, y) = \int_x^y f(u) du \text{ and that}$$

$$I_n(x, y) = \int_x^y f(u_1) du_1 \int_{u_1}^{u_1-1} f(u_2) du_2 \dots \int_{u_{n-1}}^{u_{n-1}-1} f(u_n) du_n$$

L. S. G.

517.512.3

781

Expansions in terms of associated Legendre functions. MACROBERT, T. M. *Phil. Mag.*, 35, pp. 670-680, Oct., 1944.—It is shown that a function, $f(z)$, holomorphic in the ring space bounded by 2 confocal ellipses with foci at the points ± 1 , can be expanded in the form

$$f(z) = \sum_{n=0}^{\infty} A_n (z^2 - 1)^{-\frac{1}{2}m} P_{m+n}^{-m}(z) + \sum_{n=0}^{\infty} B_n (z^2 - 1)^{\frac{1}{2}m} Q_{m+n}^m(z)$$

where A_n and B_n are certain constants, given as contour integrals around the ellipses. The function $P_{m+n}^{-m}(z)$ was introduced in a previous paper [Abstr. 996 (1944)]. Particular cases are studied, in which the second series does not occur, e.g. if $f(z)$ is holomorphic on and within an ellipse. A proof of the results for functions of a real variable satisfying Dirichlet's conditions is also given.

L. S. G.

517.512.4

782

Sums of series of the form $\sum a_n J_{n+\alpha}(z) J_{n+\beta}(z)$.

RICE, S. O. *Phil. Mag.*, 35, pp. 686-693, Oct., 1944.—The series

$$\sum_{m=0}^{\infty} a_m J_{2m+\frac{1}{2}}(z) \text{ and } \sum_{m=0}^{\infty} a_m J_{2m+\frac{1}{2}}(z) J_{-2m-\frac{1}{2}}(z)$$

where $a_m = \frac{4m+3}{(m+1)(2m+1)}$ are summed in finite

terms using the logarithmic sine and cosine functions Ciz and Siz . These series arise in an expression for the impedance of an antenna [Abstr. 355 B (1942)]. Some additional results are given, e.g.

$$\sum_{n=0}^{\infty} \frac{J_n(z) J_{n+1}(z)}{2n+1} = \frac{1}{2} z^{-1} \sin^2 z$$

L. S. G.

517.521.8

783

Euler transformations. AGNEW, R. P. *Amer. J. Math.*, 66, 2, pp. 313-338, April, 1944.—A series $u_0 + u_1 + \dots$ and its sequence of partial sums $s_0, s_1, \dots$ are said to be summable to σ by the Euler transformation $E(r)$ of order r , if $\lim \sigma_n = \sigma$, where

$$\sigma_n \equiv \sigma_n(r) = \sum_{k=0}^n \binom{n}{k} r^k (1-r)^{n-k} s_k. \quad \text{The theory of}$$

the family of methods $E(r)$ for which r is real and $0 < r < 1$ is well established and the present paper develops fundamental properties when r is a complex constant. A necessary condition for summability $E(r)$ is found and the summability of the sequence z^k is examined. This leads to 2 theorems linking the $E(r)$ method with the Borel and Cesàro methods of summability, e.g. the Borel exponential method includes $E(r)$ if and only if r is real and positive. It is also shown that the generalized Abel method includes $E(r)$ if and only if $R(r) > 0$. A family of transformations is said to be consistent if no sequence is summable to different values by different transformations of the family. The family $E(r)$ for which $r \neq 0$ is consistent. Series-to-series transformations are next considered and there is a study of the $E(r)$ summability of power series.

L. S. G.

517.521.8

784

On sequences with vanishing even or odd differences. AGNEW, R. P. *Amer. J. Math.*, 66, 2, pp. 339-340, April, 1944.—Let $x_0, x_1, \dots$ be a sequence, (x_n) , of complex numbers and

$$d_n \equiv \Delta^n x_0 = \sum_{k=0}^n (-1)^k \binom{n}{k} x_k \quad (n = 0, 1, 2, \dots)$$

denote its sequences of differences. Using the results of a previous paper [Abstr. 783 (1945)] the following theorems are proved: I. If (x_n) is bounded and $d_{2r} = 0$ ($r = 0, 1, 2, \dots$) then $x_n = 0$ for all n . II. If (x_n) is bounded and $d_{2r+1} = 0$ ($r = 0, 1, 2, \dots$) then $x_n = 0$ for $n = 1, 2, 3, \dots$. For some other results concerning the sequence see Abstr. 1946 (1944).

L. S. G.

517.6

785

The span of the translations of a function in a Lebesgue space. SEGAL, I. E. *Proc. Nat. Acad. Sci., Wash.*, 30, pp. 165-169, July, 1944.—A proof is given of the theorem: let f be an element of the space L_p whose L_p -Fourier transform exists, where $1 < p < \infty$, and impose on f the conditions: (i) the real zeros of the L_p -Fourier transform of f constitute a set of Lebesgue measure zero, (ii) the translations of f span L_p . If $p \geq 2$, (i) implies (ii). If $1 < p < 2$, (i) does not imply (ii)—there exist elements of L_p for which (i) but not (ii) holds; however, (ii) implies (i).

L. S. G.

517.6

786

On the solution of a general transform. REED, I. S. *Proc. Nat. Acad. Sci., Wash.*, 30, pp. 169-172, July, 1944.—An extension is made of the solution of a Watson transform with an unsymmetric kernel.

L. S. G.

517.942.6

787

On certain transformations in generalized hypergeometric series. BOSE, B. N. *Bull. Calcutta Math.*

Soc., 36, pp. 74-79, June, 1944.—Various expansions are obtained and Kummer's result that

$${}_2F_1[a, b; 1+a-b; -1] = \frac{\Gamma(1+a-b)\Gamma(1+\frac{1}{2}a)}{\Gamma(1+a)\Gamma(1+\frac{1}{2}a-b)}$$

is generalized. It is shown that

$${}_2F_1[a, b; 1-\alpha+a-b; -1]$$

is expressible as a finite series if α is integral. L. S. G.

517.944 : 541.124

788

Heterogeneous ion exchange in a flowing system. THOMAS, H. C. *J. Amer. Chem. Soc.*, 66, pp. 1664-1666, Oct., 1944.—A mathematical description, without approximation, is deduced of the performance of a cation exchange column, or mass of zeolite-type substance exchanging ions with the solution in which it is immersed, for the case in which the rate of the exchange is determined by a second-order law. The effect of the reverse reaction is included without approximation.

N. M. B.

517.948.33

789

An expression for the solution of a class of non-linear integral equations. CAMERON, R. H., AND MARTIN, W. T. *Amer. J. Math.*, 66, 2, pp. 281-298, April, 1944.—The equation considered is

$$x(t) = y(t) + \int_0^t G(t, \xi, x(\xi)) d\xi$$

where $G(t, \xi, u)$ is continuous in

$$0 \leq t \leq 1, 0 \leq \xi \leq 1, -\infty < u < \infty$$

The solution is obtained by taking weighted averages of all continuous functions, with heavier weights on those functions $x(t)$ which lie near the solution, i.e. functions $x(t)$ for which

$$\int_0^1 \left(y(t) - x(t) + \int_0^t G(t, \xi, x(\xi)) d\xi \right)^2 dt$$

is relatively small. The averaging process is carried out by an integration over the space C of all continuous functions $x(t)$ such that $x(0) = 0$, and the paper is written in terms of the Wiener integral. L. S. G.

517.949 : 531.252.2 = 3 see Abstr. 846

517.949 : 534.12 see Abstr. 892

518.2 : 523.841.9

790

Some tables to facilitate computation of elements of eclipsing binaries. KOPAL, Z. *Proc. Amer. Phil. Soc.*, 88, 2, pp. 145-149, 1944.—Condensed tables are given for a class of functions used in improving a preliminary set of elements of an eclipsing system by least-squares corrections, and in evaluating the photometric effects of rotational and tidal distortion of the eclipsing component. Modified second tabular differences are given for interpolation purposes. Intermediate entries to the tables can be computed from data given in the paper without loss of accuracy.

A. HU.

519.213 : 548.2 see Abstr. 1131

519.283 : 620.113.2

791

Quality control when manufacturing to specification. DUDING, B. P., AND JENNETT, W. J. *G.E.C. JI [Gen. Elect. Co.]*, 13, pp. 60-64, Aug., 1944.—[Abstr. 602 B (1945)]

519.4 : 513.761.6

792

A group-theoretic characterization of the general projective collineation group. MENDELSON, N. S. *Proc. Nat. Acad. Sci., Wash.*, 30, pp. 279-283, Sept., 1944.—Starting with an abstract group, A , certain transformations in A are defined by means of its inner automorphisms. The latter are used to define a projective geometry which has a projective collineation group isomorphic to A . A simple representation of the complete group of automorphisms of the projective collineation group is obtained and a simple specialization of the projective group yields a representation of Euclidean geometry. L. S. G.

519.45

793

On groups of automorphism of Lie groups. CHEVALLEY, C. *Proc. Nat. Acad. Sci., Wash.*, 30, pp. 274-275, Sept., 1944.—A theorem is announced concerning a Lie algebra and a sequence of algebras derived from this. Only a sketch of the proof (using the theory of ideals) is given. L. S. G.

519.47

794

Groups containing less than twenty-eight non-invariant operators. MILLER, G. A. *Proc. Nat. Acad. Sci., Wash.*, 30, pp. 275-279, Sept., 1944.—A continuation of previous papers [Abstr. 453 (1945)]. Some additional methods are here given for determining the possible groups when the number (n) of non-invariant operators is given. The methods are illustrated by a determination of all the groups for which $n < 28$. L. S. G.

521.154

795

On the movement of a cosmic cloud. ROSENBLATT, A. *Amer. J. Math.*, 66, 2, pp. 268-280, April, 1944.—The cloud is of finite dimensions and is subject only to Newton's law of attraction. A condition is found in order that the cloud remain finite, and it is also shown that if a certain inequality is satisfied, the cloud cannot tend to its centre of mass with its moment of inertia tending to zero. L. S. G.

521.6 : 523.45

796

Orbit of the ninth satellite of Jupiter. NICHOLSON, S. B. *Astrophys. J.*, 100, pp. 57-62, July, 1944.—The orbit of JIX is computed from observations in the period 1938-43. The combined attractions of Jupiter and the Sun are taken into account by computing the accelerations in Jovicentric rectangular co-ordinates for 10-day intervals. Mechanical integration of the accelerations gives co-ordinates which represent satisfactorily all the positions observed. Solar perturbations change the orbit so rapidly that ordinary osculating elements are satisfactory only for a short time, but mean elements are given for a rough description of the orbit. The mean semi-major axis is 0.1585 astronomical unit and the mean period about 758 days. A. HU.

522.612 : 523.842.2

797

Photometric observations of double stars. WALLENQUIST, A. *Ark. Mat. Astr. Fys.*, 30A, 1, No. 8, 24 pp., 1944.—A double-star photometer is described in which the brighter member of a visual binary is placed in that half of the field of view which is covered by a neutral wedge. A self-recording device eliminates the necessity of light-adapting the eye to read the wedge. The principal disadvantage is the reliance on the

wedge characteristic, but the method is quick, does not involve the loss of light inherent in polarizing photometers, and is particularly suited to wide pairs with components of very different magnitudes. The wedge const. is found from double stars already observed at Harvard and checked by observations of close stars in the Pleiades. Systematic and accidental errors are small. The mean value of the average deviation of a single observation is ± 0.185 mag. A preliminary list of double-star magnitude differences is given. A. HU.

522.612 : 535.511

798

Effect of temperature on the wavelength of a transmission band of the interference polarizing monochromator. PETTIT, E. *Astrophys. J.*, 100, pp. 128-131, Sept., 1944.—The dependence of the birefringence of quartz on temperature results in a variation of the wavelength of a transmission band in this device [Abstr. 525 (1944)] with temperature. The displacements from $H\alpha$ due to this effect in 2 monochromators are measured. The results agree with computed values for temperatures above 25°C ., but smaller shifts than theory requires are found for lower temperatures. A. HU.

523.11

799

The cosmic time-scale. HUNTER, A. *Nature, Lond.*, 154, pp. 327-328, Sept. 9, 1944.—A semi-popular account of recent theoretical work pointing to the "short" time-scale of 10^9 - 10^{10} yr. for the universe. A. HU.

523.35

800

An upper limit for the mass of the lunar atmosphere. STRUVE, O. *Astrophys. J.*, 100, pp. 104-105, July, 1944.—A summary of a paper by Fessenkoff in *Astr. J. Soviet Union*, 20, No. 2, 1943. Polarimetric observations of the faintly luminous area on the dark side of the terminator at first and last quarters, after correction for unpolarized light scattered in the Earth's atmosphere, are used to deduce that the atmospheric mass per unit cross-section above the Moon's surface is $< 10^{-6}$ that above the Earth's surface. A. HU.

523.45 : 521.6 see Abstr. 796

523.5 : 621.396.812.5

801

On whistling meteors. KHASTGIR, S. R. *Indian J. Phys.*, 17, pp. 239-245, Oct., 1943.—The origin of weak whistles of decreasing pitch, heard when a receiver is tuned to a short carrier wave, is discussed. A Doppler change in the frequency of the carrier waves scattered from an ionized mass of air at the head of a meteor would result in heterodyning with ground waves of unmodified frequency. On the other hand, the similarity to "tweaks" and "swishes" observed in a.f. amplifiers with large aerials suggests a common origin with these phenomena, viz. the modulation of the carrier waves scattered from the ionosphere by the Fourier components of an a.f. atmospheric. In the present case, the atmospheric is supposed to be an electrical impulse produced by the stoppage of a meteor in the ionosphere, its components being transmitted at different speeds by the dispersive action of the ionosphere. Test experiments are suggested for distinguishing betw. these alternatives. A. HU.

523.672

802

Comparison of the $\lambda 3883$ CN band in the spectra of comets 1940c and 1942g. MCKELLAR, A. *Astrophys. J.*, 100, pp. 69–75, July, 1944.—Strictly comparable spectrograms on the same instrument show differences in the structure of this band in the two comets. These differences are discussed in terms of the resonance theory, taking into account the contour of the exciting solar spectrum. The effects of this and of the different heliocentric distances, of the radial velocities of the comets with respect to the Sun, and of the resolution attained on the plates, adequately explain the structural differences.

A. HU.

523.73 : 523.746.5 see Abstr. 805

523.746.5

803

Note on the epoch of the next sunspot maximum. GLEISSBERG, W. *Astrophys. J.*, 100, p. 114, July, 1944.—The probability laws of sunspot variations [Abstr. 545 (1943)] predict that, in spite of the slow decrease of solar activity after the last max., the interval before the next max. will be shorter than the average of 11.1 yr. The probability that the next max. will occur before May 1948 is given as 0.95.

A. HU.

523.746.5

804

A secular change in the shape of the spot-frequency curve. GLEISSBERG, W. *Observatory*, 65, p. 244, Oct., 1944.—From Zürich records of the epochs of sunspot max. and min. going back to 1610 it is found that the ratio of the duration of ascending activity to that of descending activity has decreased steadily during the past 300 yr.; thus the max. of activity has shifted systematically forward within the solar cycle.

A. HU.

523.746.5 : 523.73

805

Note on the latitude variation of the sunspot belts. GLEISSBERG, W. *Astrophys. J.*, 100, pp. 219–220, Sept., 1944.—A simple empirical analysis shows that the speed of shifting of the sunspot belts towards the equator during the 11 yr. cycle is nearly proportional to the gradient of the Sun's rotational velocity. This relation leads to a simple mathematical expression of Spoerer's law of latitude variation.

A. HU.

523.78 : 525.721 see Abstr. 832

523.813

806

The photographic determination of stellar parallaxes with the 60- and 100-inch reflectors. VAN MAANEN, A. *Astrophys. J.*, 100, pp. 55–56, July, 1944.—Trigonometric parallaxes are given for 25 fields including 28 stars put on the observing programme on account of large proper motion. A possible white dwarf gives a negative parallax, so its abs. magnitude is probably not fainter than +8. A list adds 7 stars to the 21 already known with abs. magnitudes +15 or fainter.

A. HU.

523.832 : 523.851.3 see Abstr. 819

523.841.372.4

807

The Cepheid variable BK Aurigae. ASHBROOK, J. *Bull. Harv. Coll. Obs.*, No. 917, pp. 10–11, Dec. 1, 1943.—Estimates of brightness of this star on 2173 Harvard patrol plates show that it is a Cepheid of period 8 days and amplitude 0.7 mag. The mean light curve shows a well-defined hump on the descending branch, as in GH Cyg and W Gem, but the curve

differs considerably from those of RX Cam and U Vul, although all these stars are of the same period.

A. HU.

523.841.374

808

The cluster-type variable W Tucanae. GAPOSCHKIN, S. *Bull. Harv. Coll. Obs.*, No. 917, p. 16, Dec. 1, 1943.—A mean light curve derived from 800 observations shows a typically asymmetric variation with a hump in the descending branch.

A. HU.

523.841.9

809

The variable star S Doradus as an eclipsing binary. GAPOSCHKIN, S. *Publ. Astr. Soc. Pacif.*, 54, pp. 264–266, Dec., 1942.—Measurements of 750 plates taken in the interval 1889–1941 give a light curve suggesting that this star is an eclipsing binary of period 40 yr. and with an eccentric orbit. Photometric elements and rel. dimensions are derived. Using an effective temperature of 7130°K. , the masses of the components turn out to be 145 and 160 times that of the Sun, and their radii 1900 and 2100 times that of the Sun respectively.

A. HU.

523.841.9

810

A new bright eclipsing variable with small range, HV 11 085. GAPOSCHKIN, S. *Bull. Harv. Coll. Obs.*, No. 917, pp. 5–6, Dec. 1, 1943.—The spectroscopic binary HD 176 853 is found to be an eclipsing variable of range 0.076 mag. for primary min. Relative dimensions and photometric elements are computed, and with the aid of the spectroscopic elements, the absolute dimensions are deduced. Both components are main-sequence B stars of moderate mass, whose central temperatures and absolute magnitudes place them well within the region of the carbon cycle.

A. HU.

523.841.9

811

Note on the periods of 20 eclipsing binaries. WOODWARD, E. J. *Bull. Harv. Coll. Obs.*, No. 917, p. 7, Dec. 1, 1943.—Confirmed or revised periods and epochs of min. are given for 20 eclipsing variables, about 1000 observations of each star being used.

A. HU.

523.841.9

812

The spectroscopic orbit of BD Virginis. STRUVE, O., CESCO, C. U., AND SAHADE, J. *Astrophys. J.*, 100, pp. 181–185, Sept., 1944.—From 34 spectrograms taken on the 82 in. McDonald reflector, spectrographic elements of this eclipsing binary are obtained. Only one spectrum is visible: it is of type A5, but lines of neutral metals are strong and those of ionized metals are weak. The mass of this component is abnormally small: it probably lies betw. 0.4 and 0.1 times that of the Sun.

A. HU.

523.841.9

813

The eclipsing star BD Virginis. PAYNE-GAPOSCHKIN, C. *Astrophys. J.*, 100, pp. 186–188, Sept., 1944.—Photometric elements are deduced from 773 Harvard plates. It is a normal Algol star, of magnitude range 10.25 to 11.45, showing a grazing eclipse, the orbital inclination being 77° . If the earlier-type star is A2 the other is an F or G sub-giant. The system resembles Algol in period, light curve, dimensions and masses.

A. HU.

523.841.9

814

A study of the Wolf-Rayet eclipsing binary HD 193 576 = V 444 Cygni. KOPAL, Z. *Astrophys. J.*, 100, pp. 204–212, Sept., 1944.—Two puzzling features

of the photo-electric light curve of this binary, viz. unequal widths of the minima and the constancy of light betw. eclipses, can be explained if the Wolf-Rayet component consists of a small luminous core surrounded by an extended absorbing atmosphere too dark to contribute much to the combined light. This model accounts qualitatively for all observed features of the light curve. The effective temperature of the W core need not differ greatly from its ionization temperature, since its surface brightness is at least as high as that of the O component. Observed peculiarities in the spectrum are attributed to tides raised by the O star in the W envelope, which is so large as to be near dynamical instability. A. HU.

23.841.9

815

Provisional elements of the eclipsing binary V 444 Cygni. RUSSELL, H. N. *Astrophys. J.*, 100, pp. 213-18, Sept., 1944.—The light curve of this binary can be represented by the assumption that the effective diameter of the Wolf-Rayet component with its envelope is greater when eclipsing than at other phases, except for minor deviations indicating that it is actually very diffuse. The rel. luminosity of the components cannot be found from the photometric data, but widely different assumed values lead to practically identical light curves and to almost the same physical structure of the system. The envelope of the W star is exceedingly hot and not merely free from absorbing dust, but highly ionized. A. HU.

23.841.9 : 518.2 see Abstr. 790

23.842.2

816

Note on the double white dwarf L 462-56 = LDS 275. LUYTEN, W. J. *Astrophys. J.*, 100, pp. 202-203, Sept., 1944.—This binary of large proper motion appears from photographs in red and blue light to consist of 2 white dwarfs of about the same magnitude. A table summarizes the properties of the 7 lesser-known binaries containing a white-dwarf component; this is the only double white dwarf and holds out the greatest promise for an early determination of orbital motion and mass. A. HU.

23.842.2 : 522.612 see Abstr. 797

23.842.3

817

The spectroscopic binary 31 Cygni. VINTER HANSEN, J. M. *Astrophys. J.*, 100, pp. 8-13, July, 1944.—From 75 spectrograms taken during the period 1899-1943, radial velocities are deduced and orbital elements derived for the brighter component (a K0 supergiant) of this binary. The spectrum of the faint B-type companion is visible on a few plates in the u.v., which give approx. velocities leading to a mass ratio of 1-7. No evidence is found for any variation in systemic velocity. Apastron observations on a large reflector might reveal duplicity in April 1945. A. HU.

23.842.3

818

The spectrographic orbit and light-variations of η Geminorum. McLAUGHLIN, D. B., and VAN DUKE, S. E. A. *Astrophys. J.*, 100, pp. 63-68, July, 1944.—Radial velocities from 159 plates taken mostly in the period 1930-41 are used to derive orbital elements. The spectrographic period is 2.983 days, but irregular velocity variations are probably associated with the semi-regular light variation in a period of 234 days. Evidence as to the occurrence of an eclipse is inconclusive. A. HU.

523.851.3 : 523.832

819

Investigations on proper motion. XXIII. The proper motion of the cluster h Persei. VAN MAANEN, A. *Astrophys. J.*, 100, pp. 31-54, July, 1944.—Two pairs of plates taken on the 60 in. reflector with intervals of 29 and 17 yr. are measured to derive the proper motions of 800 stars in the central part of this cluster. The observed motions, radial velocities and colour indices, are used to separate members from non-members. The latter number 108 and include nearly all the field stars brighter than mag. 15. The final motion found is $\mu_{\alpha} = +0.0016 \pm 0.0005$; $\mu_{\delta} = -0.0033 \pm 0.0002$. A. HU.

523.852.31

820

NGC 147 and NGC 185, two new members of the local group of galaxies. BAADE, W. *Astrophys. J.*, 100, pp. 147-150, Sept., 1944.—These two elliptical nebulae are resolved on red-sensitive plates taken on the 100 in. telescope, and therefore increase the number of objects comprised in the "local group" to 13. They are of low luminosity (-10.3 and -10.6 respectively) and their structure is intermediate betw. systems like NGC 205, which begin to show departure from the typical high concentration of E nebulae, and extremely loose nebulae like the Sculptor and Fornax systems. Some features of the local group are discussed. A. HU.

523.852.32

821

The resolution of Messier 32, NGC 205, and the central region of the Andromeda nebula. BAADE, W. *Astrophys. J.*, 100, pp. 137-146, Sept., 1944.—The central region of the Andromeda nebula and its two companions are resolved into stars for the first time by using red-sensitive plates with the 100 in. telescope in ideal conditions. The brightest stars in all 3 systems are of photographic magnitude 21.3. The corresponding abs. mag. is only -1.1 . The Hertzsprung-Russell diagram of the stars concerned closely resembles that of stars in the globular clusters. It is suggested that the populations of all galaxies fall into 2 groups according to their Hertzsprung-Russell diagrams: type I (e.g. the slow-moving stars in the solar neighbourhood) with highly luminous early-type stars and open clusters, and type II (e.g. members of globular clusters and of E-Sa nebulae) in which the brightest stars are K giants of absolute magnitude about -1 , and which show cluster-type variables filling the Hertzsprung gap, globular clusters, and a high proportion of dwarfs. A. HU.

523.872

822

On the absorption coefficient of the negative oxygen ion. WILDT, R., and CHANDRASEKHAR, S. *Astrophys. J.*, 100, pp. 87-93, July, 1944.—The ionization continuum of O^- in the ultra-violet may become so strong in late K- and M-type stars that its contribution to the monochromatic absorption coefficient cannot be neglected. A discontinuity in gM spectra near $\lambda 4050$ is tentatively identified with the O^- absorption edge. The theoretical strength of this discontinuity depends on the abundance ratio of atomic O to atomic H, which varies with pressure through the effect of molecular association. The proposed interpretation does not involve an unreasonably large difference in O abundance betw. giants and dwarfs. A. HU.

523.872

823

Doubly ionized rare earths in α^2 Canum Venaticorum. SWINGS, P. *Astrophys. J.*, 100, pp. 132-136, Sept., 1944.—The strongest lines of Eu III, Gd III, Ce III, Sa III and La III in the region 3 070-3 300 Å are identified in the spectrum of this star. Both in intensity and in radial velocity they vary with phase as do the lines of the corresponding singly ionized elements. The bearing of this fact on previous theories concerning the rare-earth lines in α^2 CVen is indicated. Several previously unidentified lines in the blue-violet region are attributed to Dy III. A. HU.

523.872

824

The helium anomaly in ϕ Persei. HYNEK, J. A. *Astrophys. J.*, 100, pp. 151-157, Sept., 1944.—The behaviours of the triplet (4 026, 4 471 Å) and singlet (3 965 Å) lines of He I in this star are contrasted. The singlet shows variable radial velocities in phase with the Balmer lines. The triplet lines are composite, and are for the most part 180° out of phase. The velocity curve from the major component is complex, one part corresponding to the phase (45-70 days) of enhancement of the He lines, the other to the rest of the 127-day cycle. Possible physical causes of the anomaly are discussed. A. HU.

523.872

825

Some remarks on the negative hydrogen ion and its absorption coefficient. CHANDRASEKHAR, S. *Astrophys. J.*, 100, pp. 176-180, Sept., 1944.—It is suggested that a form of the wave function for the ground state of H⁻ should be sought which recognizes that the electron affinity of hydrogen is due to the incomplete screening of the nucleus and to the polarization of the hydrogenic core. A second approximation on these lines is made and suggests that further terms could be profitably included. Attention is drawn to certain facts which make the evaluation of the continuous absorption coefficient of H⁻ a problem of extreme difficulty. A. HU.

523.874

826

Spectroscopic observations of 48 Librae. MERRILL, P. W., AND SANFORD, R. F. *Astrophys. J.*, 100, pp. 14-30, July, 1944.—The radial velocity of this star was const. betw. 1904 and 1931, but betw. 1935 and 1944 a fluctuation of large amplitude occurred. A progression in displacement from line to line along the Balmer series is observed, the velocities from metallic lines agreeing with those of H lines near the head of the series. Stationary Na I and Ca II lines are probably partly interstellar and partly circumstellar. The dark lines of H and of the metals became stronger from 1938 to 1943, the 90% absorption in the core of H α showing that absorbing atoms lay in front of most of the emitting atoms. Asymmetry in the lines cannot explain the displacements, which are attributed to motions in the stellar atmosphere. The amplitude of the fluctuations probably increases from the photosphere outwards. The bright H lines may come from a layer of hydrogen just above the photosphere. A. HU.

523.874

827

Radial velocities of twenty stars of early type in and near the galactic cluster NGC 6231. STRUVE, O. *Astrophys. J.*, 100, pp. 189-201, Sept., 1944.—A group

of bright stars apparently physically related to this cluster is investigated. Radial velocities of the 16 which show normal spectra (cO9 to cB2) are compared with those obtained from different features in the spectra of the 4 peculiar stars (WC 6, WN 7, O7f, O7f). The emission lines in the WN star and the two P-Cygni stars show appreciable red shifts and are accompanied by violet absorption borders. Central absorption cores to some of the emission bands in the WC star, and the emission bands themselves, show large variable violet shifts. A. HU.

523.876

828

Studies of faint B-type stars. II. POPPER, D. M. *Astrophys. J.*, 100, pp. 94-103, July, 1944.—Radial velocities and spectral types are listed for 150 B-type stars of magnitude 8-12 distributed fairly uniformly along the Milky Way. Using these results and those of a previous paper [Abstr. 1479 (1941)], the distributions in galactic longitude of spectral types, radial velocities and K-line velocities are exhibited graphically. A. HU.

523.877

829

On the radiative equilibrium of a stellar atmosphere. II. CHANDRASEKHAR, S. *Astrophys. J.*, 100, pp. 76-86, July, 1944.—A new method is described for solving various problems of radiative transfer in stellar atmospheres. The integral occurring in the equation of transfer is expressed as a sum, using Gauss's formula for numerical quadratures, and the integro-differential equation is replaced by a system of linear equations whose general solutions can be readily obtained. The method is applied to an earlier problem [Abstr. 1530 (1944)] for which the first few approximations are obtained and the corresponding laws of darkening are derived. A new and elementary proof is given of the exact relation betw. the boundary temperature and the effective temperature. A. HU.

523.877

830

On the radiative equilibrium of a stellar atmosphere. III. CHANDRASEKHAR, S. *Astrophys. J.*, 100, pp. 117-127, Sept., 1944.—The equation of transfer applicable when the anisotropy of the scattered radiation is described by Rayleigh's law is solved by a method previously described [Abstr. 829 (1945)]. The general solution in the n th approximation is explicitly worked out, and the numerical forms of the first four approximations found. A. HU.

523.877

831

Partially degenerate stellar models. WARES, G. W. *Astrophys. J.*, 100, pp. 158-175, Sept., 1944.—Models based on Fermi-Dirac statistics are used to study stars which are too degenerate at the core for the perfect-gas law to apply, but not dense enough for the white-dwarf models to be valid. Two assumptions as to the temperature gradient and the distribution of energy sources are made; the corresponding models studied are the standard model and the isothermal gas sphere. The former leads to the accurate solution of Milne's problem for small masses. In the latter, finite configurations are found only if the central degeneracy is not too low. The theory applies to extreme subdwarfs and perhaps to old novae, but probably not to any main-sequence stars. A. HU.

525.721 : 523.78

832

An observation on the ionosphere during the solar eclipse of July 20, 1944. JEN, G. K., CHOW, K. T., LO, Y. T., AND KUAN, C. C. *Phys. Rev.*, 66, p. 226, Oct. 1 and 15, 1944.

525.75 : 551.521.6

833

A strong infra-red radiation from molecular nitrogen in the night sky. STEBBINS, J., WHITFORD, A. E., AND SWINGS, P. *Phys. Rev.*, 66, pp. 225–226, Oct. 1 and 15, 1944.

53 : 623.8/9

834

Physics in the Navy. ELDER, F. K., TIEDEMAN, J. A., KINSLER, L. E., RIGGIN, J. D., PINKSTON, E. R., AND GOODWIN, R. A. *Amer. J. Phys.*, 12, pp. 279–302, Oct., 1944.

53.081.5 : 621.317.081.5

835

On the dimensions of physical magnitudes (fifth paper). DINGLE, H. *Phil. Mag.*, 35, pp. 616–618, Sept., 1944.—A reply to criticism [Abstr. 2376 (1944)] of previous papers of the series [Abstr. 76 (1944)].

L. S. G.

53.082 : 621.317 : 621.385

836

Electronics in instrumentation. MIDDEL, H. D. *Gen. Elect. Rev.*, 47, pp. 9–16, Nov., 1944.—[Abstr. 855 B (1945)].

530.12

837

Foundations of kinematical relativity. WALKER, A. G. *Observatory*, 65, pp. 242–243, Oct., 1944.—A hypothesis of the universe is adopted in which spherical symmetry is supposed to exist locally around each nebula. A model based on this satisfies Milne's cosmological principle *a posteriori*. The set of transformations which relate all the different observers in the system is sought; it is of the same general form whether the cosmological principle or the hypothesis of local symmetry is assumed, the transformations being those which leave invariant the metric of a Riemannian 3-space of const. curvature. A definitive relation betw. fundamental particles which is primitive and independent of clock graduations and measurements of any kind is proposed in place of Milne's equivalence postulate.

A. HU.

530.12

838

Static isotropic solutions of Einstein's field equations. WYMAN, M. *Phys. Rev.*, 66, pp. 267–274, Nov. 1 and 15, 1944.—Line elements of the form $ds^2 = V^2 dt^2 - (dl^2/W^2)$ are considered, where $V = V(x, y, z)$, $W = W(x, y, z)$. When the components of the energy momentum tensor T^i_j satisfy the equations $T^1_1 = T^2_2 = T^3_3$, $T^i_j = 0$, $i \neq j$, it is shown that V, W are reducible to 3 basic forms. The basic solutions in empty space are determined. All isotropic solutions, in empty space, can be obtained from the basic solutions by means of transformations that are given.

530.12 : 531.51

839

Flat space-time and gravitation. BIRKHOFF, G. D. *Proc. Nat. Acad. Sci., Wash.*, 30, pp. 324–334, Oct., 1944.—A short review is made of early attempts to incorporate gravitational phenomena in flat space-time, the difficulties being especially noted. A simple theory, agreeing with all known gravitational phenomena and free of arbitrary constants, was recently proposed [Abstr. 79 (1944)] and a more detailed

exposition is now given, attention being paid particularly to the foundations [see Abstr. 1955 (1944), 488 (1945)].

L. S. G.

530.12 : 537.12 : 512.972

840

On the theory of point-particles. BHABHA, H. J., AND HARISH-CHANDRA. *Proc. Roy. Soc. A*, 183, pp. 134–141, Nov. 30, 1944.—It is deduced from the conservation of the energy-momentum tensor that if the flow of energy and momentum into a tube surrounding a time-like world-line, on which the field is singular, become singular as the size of the tube is contracted to zero, then the singular terms are necessarily perfect differentials of quantities on the world-line with respect to the proper time along the world-line. The same can be proved of any other tensor which is conserved. It is proved from this that, for any point-particle having charge, spin or other properties, which need not be specified, it is always possible to deduce exact equations of motion which are finite. It is proved that, if the energy-momentum tensor is altered by the addition of $\partial K_{\mu\nu\sigma}/\partial x^\sigma$, where $K_{\mu\nu\sigma}$ is any tensor antisymmetric in ν and σ , then the equations of motion are unaltered. but it is possible to choose $K_{\mu\nu\sigma}$ to make the flow of energy and momentum into a given tube non-singular.

530.12 : 537.12 : 512.972

841

On the removal of the infinite self-energies of point-particles. HARISH-CHANDRA. *Proc. Roy. Soc. A*, 183, pp. 142–167, Nov. 30, 1944.—[See Abstr. 840 (1945)]. A general method is set up for modifying the energy-momentum tensor so as to remove the singularities in the flow of energy and momentum into the world-line of a particle without affecting the equations of motion of the particle. It is shown how the singularities of different order may be removed one by one. In the case of the electromagnetic and meson fields it is shown that the modified tensor leads to a finite integral of energy and momentum over any space-like surface. In other cases the corresponding result may be secured by making a further modification in the tensor.

531.21 : 621.3.012.8

842

Equivalent circuits of the elastic field. KRON, G. *J. Appl. Mech.*, 11, A149–A161, Sept., 1944.—Equivalent electrical circuits are devised which represent the partial differential equations of the theory of elasticity; an equivalent circuit must satisfy Hooke's law, the equations of equilibrium between the stresses and the conditions of compatibility between the strains. These correspond respectively to Ohm's law, Kirchhoff's 2nd law of currents and 1st law of voltages. The network pattern is established by the integral approach to the physical problem and the network constants are found from the differential equations. Networks are drawn for small oscillations, transient and steady states, and other cases. An explanatory appendix is added.

G. E. A.

531.21 : 621.3.012.8

843

Numerical and network-analyser solution of the equivalent circuits for the elastic field. CARTER, G. K. *J. Appl. Mech.*, 11, A162–A167, Sept., 1944.—Tests of equivalent circuits [see Abstr. 842 (1945)] were made in the cases of static plane strain under simple tension, uniform shear and simple bending, in rectangular co-ordinates, and plane strain in polar

co-ordinates. The tests indicate that the mesh size in the circuits need not be excessively small to give useful accuracy. It is also found by trial that solution of the circuits is practicable with the use of a relaxation method.

G. E. A.

531.224.4 : 536.581

844

Analysis of the Valverde thermostat. WAHL, A. M. *J. Appl. Mech.*, 11, A183-A189, Sept., 1944.—The Valverde thermostat (U.S. Pat., 1987166 and 1987167) consists essentially of 3 strips of bimetal, 1 inner and 2 outer strips, the latter being crimped to put them in tension. The crimping shortens the outer strips and causes the unit to bend. The curvature is sensitive to temperature, and when free, the direction of the curvature changes suddenly at upper and lower critical temperatures. In practice one end of the thermostat carries the contacts while the other end may be rotated by means of an arm and an adjusting screw. A method based on the theory of initially curved bars axially loaded is described for calculating the effect of changes of design on the critical temperatures and stresses.

R. W. P.

531.25 : 624.5

845

Theory of suspension bridges. TIMOSHENKO, S. P. *J. Franklin Inst.*, 235, pp. 213-238, March, and pp. 327-349, April, 1943.—Methods of analysis of suspension bridges are presented with their application to several particular bridges. The cases of a perfectly flexible cable and of an unstiffened bridge are first discussed, and equations for calculating deflections and changes in cable tension due to live load are developed. Heavy long-span bridges do not require a stiffening truss. The fundamental equations for stiffened bridges are then derived, and the errors introduced by various assumptions are considered. An analysis of a single-span stiffened bridge is given, using a simplified method of derivation. By the use of trigonometric series, the calculation of deflections and bending moments is simplified, and the calculation of cable tension under live load can be made with greater accuracy. The theory of a suspension bridge with a continuous stiffening truss is given, with equations for effect of live load and for bending moments at the towers. In the problem of a stiffening truss, trigonometric series are employed with advantage.

G. E. A.

531.252.2 : 517.949 = 3

846

Plane problems of strain and the calculus of finite differences. STOCKER, J. J. *Schweiz. Arch. angew. Wiss. Tech.*, 10, pp. 203-209, July, 1944.—The state of strain is found in a square plate along a diagonal of which a given force acts. The method is theoretical and consists in solving the equation $\nabla^4 w = 0$, by first solving the equation $\nabla^2 u = 0$ and then $\nabla^2 w = u$. These differential equations are solved by the familiar finite-difference method of approximation. The results are presented in graphical form.

L. S. G.

531.258

847

Boundary-value problems of circular discs under body forces. I. SEN, B. *Bull. Calcutta Math. Soc.*, 36, pp. 58-62, June, 1944.—The method of a previous paper [Abstr. 3499 (1938)] is extended to apply to problems of circular discs involving gravitational body forces and the reversed effective forces due to steady rotation. The problem considered is that of deter-

mining the stress of a heavy circular disc rotating steadily in a vertical plane about a horizontal central axis.

L. S. G.

531.258

848

The bending of the clamped sectorial plate. CARRIER, G. F. *J. Appl. Mech.*, 11, A134-A139, Sept., 1944.—Expressions are derived for the b.m. along the edge of a plate having the form of a sector of a ring [see Abstr. 174 (1941)]. A reduction in the computational work is achieved by the use of an integral-equation method of solving the boundary-condition equations. Numerical results are obtained for plates of various dimensions, and the edge moment distributions are plotted for these cases.

531.259

849

On the divergence of the solution of a problem of plane strain. GHOSH, G. *Bull. Calcutta Math. Soc.*, 36, pp. 51-57, June, 1944.—Problems are considered in which certain divergent integrals arise. By using the notion of the finite part of a divergent integral it is possible to obtain useful results, e.g. the components of displacement at any point of an infinite elastic solid due to an infinite line distribution of force of uniform density, the forces being co-planar and perpendicular to the line.

L. S. G.

531.383 : 621.34

850

Electrically operated gyroscopic instruments. KONET, H. *Trans. Amer. Inst. Elect. Engrs.*, 63, pp. 735-738, Oct., 1944.—[Abstr. 800 B (1945)].

531.383 : 623.43 : 621-522 : 621.316.71

851

Gyroscopic stabilizer for tank guns. HANNA, C. R., AND LYNN, L. B. *Elect. Engng. N. Y.*, 63, pp. 355-360, Oct., 1944.—[Abstr. 719 B (1945)].

531.51 : 530.12 see Abstr. 839

531.55/.57 : 623.5

852

Ballistics of small-arms ammunition. BACON, R. H., AND KROEGER, W. J. *Amer. J. Phys.*, 12, pp. 269-278, Oct., 1944.—Details are given of interior and exterior ballistics. The sensitivity of primers must be kept under close control and they must have uniformity of ignition. The ignition test depends on the fact that when bullet and powder gases leave the muzzle, they are electrically charged and signals are electrically recorded as the bullet passes through an insulated ring. The rate of burning of the propellant charge must be regulated, the flash at the muzzle reduced, the storage life increased, and the moisture content kept constant. The pressure gauge indicates for many types of cartridges a pressure between 3 000 and 4 000 atm. In exterior ballistics the equations of motion show that the path of a precessing bullet is a helix. The velocity may be up to 3 000 ft./sec. and the spin up to 3 600 rev./sec. The resistance is expressed for various ranges of velocity and the electrostatic chronograph and other methods of measuring the velocity of the bullet are described.

G. E. A.

531.717 : 621.317.39

853

Testing the thickness of non-ferrous castings. THORNTON, B. M. *Engineering*, 159, pp. 81-83, Feb. 2, 1945.—[Abstr. 761 B (1945)].

531.717.1 : 621.357.7

854

Thickness measurements of electro-deposited metals. SALTONSTALL, R. B. *Metal Finish.*, pp. 606-609 and 638, Oct., 1944.—Thickness specifications are dis-

cussed and relative merits of direct measurements, timing processes, weighing operations, magnetic measurements and electrolytic tests are discussed.

M.-V.

531.718 : 621.317.39

855

Measuring taper and tension. CATLIN, F. H. *Gen. Elect. Rev.*, 47, pp. 19-20, Nov., 1944.—[Abstr. 762 B (1945)].

531.724 : 532.696 : 536.658 : 541.183.5 see Abstr. 1118

531.761 : 621.316.5.064.2 : 621.317.39

856

Measuring arc duration. QUILL, J. S. *Gen. Elect. Rev.*, 47, pp. 22-24, Nov., 1944.—[Abstr. 764 B (1945)].

531.77

857

Axipetal force and acceleration. TEA, P. L. *J. Franklin Inst.*, 237, pp. 131-137, Feb., 1944.—A conical pendulum is operated over a turntable by a spring motor; the range of r.p.m. is from 60 to 110. The highest speed is 2 r.p.s. and the max. deflection 60°. The pendulum weighs about 7 g. and its length can be varied between 7 and 13 cm. The apparatus is intended for laboratory and lecture use, and there follows a closer study of the transient motion and oscillations of the pendulum.

G. E. A.

531.775 : 621.317.39

858

Recent advances in aircraft tachometer design. BALLARD, R. G., AND HALL, C. P. *Trans. Amer. Inst. Elect. Engrs.*, 63, pp. 646-648, Sept., 1944.—[Abstr. 765 B (1945)].

531.775 : 621.317.39

859

Electronic counter and tachometer. DOWNIE, E. G. *Gen. Elect. Rev.*, 47, pp. 50-52, Nov., 1944.—[Abstr. 766 B (1945)].

531.775 : 621.317.39

860

Variable-speed motor and electric tachometer. MILLER, P. H., JR. *Rev. Sci. Instrum.*, 15, p. 348, Dec., 1944.—[Abstr. 767 B (1945)].

[531.787 + 536.46 + 536.58] : 669.18 see Abstr. 1169

532.123 : 581.189.1 : 532.62 see Abstr. 870

532.133 : 532.771

861

The effect of solvent type on the viscosity of very dilute solutions of long-chain polymers. FRITH, E. M. *Trans. Faraday Soc.*, 41, pp. 17-27, Jan., 1945.—A semi-quantitative discussion is given of the viscosity relationships of polymers in various solvents. Quasi-thermodynamic reasoning, based on modern statistical theories, show how the slope of the ordinary viscosity/concentration ($\eta_{sp}/c - c$) curve is related to the interaction energy between solvent and polymer, and it is shown how small differences in interaction energy appreciably alter the slope. These differences are traced back to slight kinking of the long molecular chains in agreement with the qualitative views of Mark. Retention of a solvent effect on $[\eta]$ at zero conc. is demonstrated but not proved; it is inferred that more extensive coiling of the chains is necessary than the slight kinking which affects the slope.

532.133 : 541.182.6

862

Viscosity and rigidity of structural suspensions. ROLLER, P. S., AND STODDARD, C. K. *J. Phys. Chem.*, 48, pp. 410-425, Nov., 1944.—During structural viscous flow, the structure is broken and the suspension consists of a concentrically disposed composite of liquid suspension and undecomposed residue.

The transition of a structural suspension from its rigid state during rest to its broken state during viscous flow is analysed. At a sufficiently high mean rate of shear, the structure is completely decomposed, and the viscosity, hitherto decreasing with increase in rate of shear, becomes const. At const. viscosity, the structural suspension is equivalent to a simple suspension having discrete particles. The application of the Einstein equation to structural suspensions in the range of const. viscosity is discussed. At zero rate of shear, the shear stress for a structural suspension is zero. Although a breaking strength exists, it may be determined only with angular displacement as variable. It cannot be measured with mean rate of shear as variable, and any result obtained in this way is fictitious. At zero rate of shear a singular condition does exist for a structural suspension, which is that the viscosity be infinite.

532.133 : 541.182.6 see Abstr. 1105

532.133 : 541.24

863

Viscosities of molten coumarone-indene resins. ZETTMAYER, A. C., AND KUTOSH, S. *Industr. Engng Chem.*, 36, pp. 942-944, Oct., 1944.—The average mol. wt. of coumarone-indene resins may be determined by the measurement of their molten viscosities; a simple equation connects the viscosity and mol. wt. at any temperature between 150° and 180°C.

532.14 : 536.423.1 : 541.6 : 535.324 see Abstr. 899

532.217.3 : 621.317.39.083.8

864

Totalizing contents of aircraft fuel tanks. MACINTYRE, J. R. *Trans. Amer. Inst. Elect. Engrs.*, 63, pp. 663-665, Sept., 1944.—[Abstr. 771 B (1945)].

532.322 : 534.01 see Abstr. 889

532.517.2

865

On the stability of two-dimensional parallel flows. LIN, C. C. *Proc. Nat. Acad. Sci., Wash.*, 30, pp. 316-324, Oct., 1944.—A brief and introductory paper. The theory of Heisenberg concerning the stability is critically examined, modified and developed. The study commences with the equation of Orr and Sommerfeld for a two-dimensional periodic disturbance in a field of flow. Two methods of successive approx. to the solution are given. A particular emphasis is made on general criteria of instability and their underlying physical mechanism, both in a non-viscous fluid and in a real fluid. It is found that the Poiseuille flow and the Blasius flow are both unstable at sufficiently high Reynolds numbers. A brief statement is made concerning the transition to turbulence.

L. S. G.

532.525

866

On the reaction of fluids and fluid jets. EKSERGIAN, R. *J. Franklin Inst.*, 237, pp. 385-410, May, 1944.—The following matters are discussed mathematically: jet propulsion with special emphasis on methods of analysis giving the reactions on moving or stationary constraining channels; reaction of a fluid on a moving blade system; theory of a rotating nozzle with expanding fluid including the calculation of stresses and reaction on the nozzle; efficiency of rocket propulsion; mixing of fluids, and ejectors; pressure drop along a converging-diverging nozzle, and fluid shock.

J. S. G. T.

532.532

867

Flow over quadratic weirs and over weirs with discharge proportional to head. WALKER, R. McC. *J. Instn. Civ. Engrs.*, 23, pp. 42-48, Nov., 1944.—The general mathematical theory of the discharge of fluid over a weir represented by an equation of the second degree in x and y is developed, and is applied to the special cases of parabolic, triangular, elliptic, hyperbolic and circular weirs. Experimental and theoretical results agree closely in the cases of parabolic, hyperbolic and elliptic weirs, the only ones investigated experimentally. Rettger's proportional-flow weir in which the theoretical discharge is very nearly $\propto$ head is briefly discussed. A new type of proportional-flow weir, the equation of which is $x^2y = -c$, and an orifice weir in which the discharge is theoretically $\propto$ head are briefly discussed. Experimental results confirm the accuracy of the theory applied to the Suto and variable-sill weirs.

J. S. G. T.

532.542

868

Relation between area and velocity for isothermal gas flow. BINDER, R. C. *J. Franklin Inst.*, 237, pp. 43-47, Jan., 1944.—Relations are established for the isothermal flow of a gas through a frictionless tube of varying cross-section. The max. velocity attainable at the throat of a convergent tube is the isothermal acoustic velocity, c , where $c = (gRT)^{1/2}$. The corresponding critical pressure, $p_c = 0.606p_1$, where $p_1 =$ inlet pressure. For a frictionless adiabatic process given by $pv^k = \text{const.}$, the acoustic velocity is $(kgp)^{1/2}$ and the critical pressure

$$p_c = p_1[2/(k+1)]^{k/(k-1)} \simeq 0.53p_1$$

for normal air.

R. W. P.

532.614 : 536.775

869

Studies in the molecular forces involved in surface formation. II. Surface free energies of simple liquid mixtures. BELTON, J. W., AND EVANS, M. G. *Trans. Faraday Soc.*, 41, pp. 1-12, Jan., 1945.—The surface free energies of binary liquid systems which form perfect solutions are calculated by a statistical method. This treatment is shown to be consistent with the Gibbs thermodynamic discussion of surfaces of discontinuity. The equation (I) derived gives the surface tension of an ideal liquid mixture in terms of the surface tension of the pure components and the composition. The treatment is extended to certain special cases of solutions which are not perfect. It has been assumed that the mol. areas of the two species are the same, but some of the conditions for a perfect solution may hold even if the ratio of the mol. areas lie between 1 and 1.59. The case is examined of a perfect solution in which the molar vols. of the components are not the same, and an equation is derived. Equation (I) gives good agreement with experimental data when the mixtures are ideal, but discrepancies are found when there is a departure from ideal behaviour. Data for both cases are tabulated, and causes of discrepancies are examined and discussed.

N. M. B.

532.62 : 532.123 : 581.189.1

870

The spore discharge mechanism of common ferns. KING, A. L. *Proc. Nat. Acad. Sci., Wash.*, 30, pp. 155-161, July, 1944.—Evidence is given which indicates that the annular cells of a spore-filled mature sporangium contain water, and that this water is ruptured

at the time of bubble formation. Computations based on the size of sporangia, Young's modulus of the annulus, and initial speed and range of spores, yield additional evidence for the belief that the tensile strength of water is around 200 atm. A sporangium can evert again and again by alternate imbibition of water and desiccation after the spores have been expelled, even in the case of herbarium specimens more than 15 years old.

H. H. HO.

532.62 : 536.423

871

Undercooling and rate of condensation in steam. RUEDY, R. *Canad. J. Res. A*, 22, pp. 77-94, Nov., 1944.—The first and most difficult stage in the condensation of water vapour is the increase in the size of the drops until their radius satisfies the Kelvin-Helmholtz equation for the degree of undercooling or supersaturation reached at the temperature T_c of the vapour; the second stage is the increase in size by continued addition of molecules until the v.p., $p(v)$, of the drop containing v molecules approaches the pressure p_∞ exerted at the same temperature by a pool of water. A gradual enlargement to visible drops follows. Consideration of the number of collisions of the molecules with the drops forming at the v.p. p_c of steam, and the loss of molecules by virtue of the higher v.p. of small drops leads to the conclusion that, at condensation temperatures between 0° and 50°C. , the centres of condensation in the absence of dust or ions contain < 100 molecules. When the degree of supersaturation corresponds to larger drops, condensation is bound to fail. The conclusion drawn from the theory is confirmed by the values obtained in the tests with flowing steam and with cloud chambers. At higher temperatures, larger drops act as nuclei. The growth in the second stage is also extremely rapid, at least until the radius equals in size the wavelength of visible radiation. Water drops of this size, that is, drops that produce coloured diffraction rings, behave as large drops. The heat of condensation may furnish part of the work to be performed against the surface tension.

532.62 : 536.423.8 see Abstr. 947

532.64 : 541.182.6

872

Wetting power in calcium-soap-oil systems. GALLAY, W., AND PUDDINGTON, I. E. *Canad. J. Res. B*, 22, pp. 155-160, Nov., 1944.—Contact angles of various mineral oils and water on relatively polar and non-polar Ca stearate surfaces prepared by special means were measured. Pre-moistening of the soap surface with small quantities of water decreased the subsequent contact angle against oil. The effect of the polarity of the oil was determined, and the action of water in the system is discussed. The sedimentation volume of Ca stearate in mineral oil, with and without various added materials, was measured. Water, glycerol and alcohol, effected an agglomeration of the suspended soap, and less polar liquids had no effect. Fatty acid in small quantities brought about a swelling of the soap at room temperature. The relation between wetting power and sedimentation volume is discussed.

532.64.08

873

An apparatus to measure contact angles. BEAMENT, J. W. L. *Trans. Faraday Soc.*, 41, pp. 45-47, Jan., 1945.—The apparatus described is being used to

investigate variations with temperature in the hydrophilic properties of lipid extracts of the insect cuticle and changes in the surface of the cuticle after moulting, by measurement of the angle of contact of water droplets. A transmitting and reflecting prism is placed in front of the eyepiece so that the image of a protractor reflected in a mirror at 45° to the system is brought into superposition with the image of the droplet and the hairline. The positions of the components are adjusted so that in the field of view, the base line of the protractor is in line with the edge of the coverslip, or insect surface, with the protractor centre at the edge of the drop and at the optical centre of the microscope. Having obtained unity of plane by elimination of ellipses in the various images, rotation of the hairline gives perfect alignment with the graduations of the protractor.

532.68 : 676

874

Movement of solutions in paper. LIESEGANG, R. E. *Papierfabrikant*, 41, p. 219, 1943.—Certain substances normally present in paper (e.g. dyestuffs, such as Rhodamine) retard the capillary rise of water through unsized paper by blocking the pores; other substances (e.g. certain wetting agents, and inks containing glycerin) accelerate it. In making sizing tests by this and by the flotation method, it is important to distinguish between the effects of capillarity and diffusion.

J. G.

532.69 : 539.216.1 see *Abstr.* 1011

532.694.1

875

The measurement of foam stability. BRADY, A. P., AND ROSS, S. J. *Amer. Chem. Soc.*, 66, pp. 1348–1356, Aug., 1944.—Foam stabilities of several types of commercial oils were measured between 25° and 120°C . by a foam meter in which foaming is produced by bubbling dry N_2 through a porous ceramic bubbler or sintered glass membrane into the test oil. Static foam units L_f , L_b , and L_g (life times of foam, liquid in foam, and gas in foam) are evaluated, and factors on which they depend are discussed. L_g can be converted into a function which expresses the static foam stability of a liquid and which, for foams of the same character, depends on temperature, viscosity, amount of liquid sample, method of foam production, and dimensions of apparatus.

W. R. A.

532.694.1 : 541.182

876

Foam stability of solutions of soaps of pure fatty acids. MILES, G. D., AND ROSS, J. J. *Phys. Chem.*, 48, pp. 280–290, Sept., 1944.—The effect of alterations in pH upon relative foam stability is examined for 0.1% solutions of Na caprate, laurate, myristate, palmitate, and stearate. Relative foam stability as a function of conc. was measured at 57°C . for solutions of Na caprate, laurate, myristate, palmitate, stearate, undecylenate, oleate, elaidate, and ricinoleate at the pH where each solution showed max. foam. The pH range associated with the max. foam stability for these soaps as a function of conc. was determined at 57°C . The influence of Ca and Mg soaps upon the foam stability of solutions of the corresponding Na soaps was examined. The effect of temperature upon the relationship of pH to foam stability was studied for Na caprate and laurate. The effect of temperature on the foam stability of all the soaps was ascertained at 27° to 82°C . The effect of pH on the foam stability

of mixtures of Na laurate and palmitate was determined.

532.696 : 536.658 : 531.724 : 541.183.5 see *Abstr.* 1118

532.712

877

An easily constructed Hepp osmometer. REHM, W. S. *Science*, 100, p. 364, Oct. 20, 1944.

532.712.08

878

Osmometry of high-polymer solutions. WAGNER, R. H. *Industr. Engng Chem. (Analyt. Edit.)*, 16, pp. 520–523, Aug., 1944.—A glass osmometer of simple design is described which is especially useful for o.p. measurements of high-polymer solutions that tend to form a stable foam. The assembly and operation of the osmometer are described and data are presented to illustrate the order of reproducibility obtained.

532.713 : 532.77 : 541.132

879

Isotonic solutions; activity coefficients of sodium bromate and potassium chlorate. JONES, J. H., AND FRONING, H. R. *J. Amer. Chem. Soc.*, 66, pp. 1672–1674, Oct., 1944.—The concentrations of isotonic solutions of $\text{NaBrO}_3\text{--NaCl}$ and $\text{KClO}_3\text{--NaCl}$ were determined from 0.2M to saturation, using the method of Jones [*Abstr.* 2529 (1943)]; and the activity and osmotic coefficients calculated by comparison with NaCl. The solubility of NaBrO_3 in H_2O at 25° was measured.

W. R. A.

532.713 : 536.423.15 : 541.132

880

A thermodynamic study of bivalent metal halides in aqueous solution. XI. The osmotic and activity coefficients of zinc iodide at 25° . STOKES, R. H. *Trans. Faraday Soc.*, 41, pp. 12–17, Jan., 1945.—Isopiestic v.p. measurements were made on ZnI_2 solutions at 25° . The values obtained for the v.p. and activity coefficients are consistent with the e.m.f. measurements of Bates but differ considerably from those of Egan and Partington. Up to an ionic strength of unity, the activity coefficients are given within experimental error by the extended Debye-Hückel equation. There is evidence that complex-ion formation begins to play a significant part in solutions more concentrated than 1M.

532.72

881

Diffusion of the lower alkyl sulphonic acids and some large molecules. MCBAIN, M. E. L. *J. Phys. Chem.*, 48, pp. 237–241, Sept., 1944.—The diffusions reported for the lower alkyl sulphonic acids do not show the characteristic min. of colloidal electrolytes, but resemble half-strong electrolytes. The diffusion of other large mols. is given, the value indicating that even large long mols. roll into spheres when given an opportunity to diffuse, and that the separated charges on zwitter-ions are accompanied in diffusion by free gegen-ions.

N. M. B.

532.739.2

882

Effect of repeated treatment of corn cob lignin by the 72% sulphuric acid method. DRYDEN, E. C., REID, J. D., AND ARONOVSKY, S. I. *Paper Tr. J.*, 119, TAPPI Sect., pp. 115–116, Sept. 14, 1944.—The lignin was digested with the acid for 2 hr. at 20° , water was added to produce 3% acid, and the mixture was boiled for 2 hr. and filtered. The dried and weighed residue was re-treated similarly 4 times.

The resulting partial degradation and solution of the lignin decreased progressively with each treatment.

J. G.

532.739.2

883

Gas-liquid solubilities and pressures in presence of air. OTHMER, D. F., KOLLMAN, R. C., AND WHITE, R. E. *Industr. Engng. Chem.*, 36, pp. 963-966, Oct., 1944.—Apparatus is described. The air is saturated with the constituent dissolved in the liquid phase. Partial-pressure data for the system acetone-water are presented which have been determined in the presence of air. The solubilities and partial pressures of acetone in 2 mineral oils were also determined in the presence of air.

532.739.2 : 661.713

884

Determination of the alkali solubility of cellulose. *Svensk Papp. Tidn.*, 47, pp. 190-194, 1944.—The new Swedish standard method is described. It is more rapid than the existing methods, and more independent of temperature variations and of the moisture content of the sample; the results obtained are somewhat lower.

J. G.

532.771 : 541.132 : 532.713 see Abstr. 879

532.771 : 532.133 see Abstr. 861

532.785 : 535.515 : 941.182.6 see Abstr. 1106

533.5

885

Instruments for the measurement of pumping speed of high-speed vacuum pumps. ALEXANDER, P. *J. Sci. Instrum.*, 21, pp. 216-219, Dec., 1944.—An instrument was developed for measuring at const. vol. and varying pressure. Manual operation of a stopcock over a given time, and 2 readings of a manometer, are necessary for pumping speed to be deduced. Accuracy may be as high as desired by using suitable values. Constructional details and the mathematical theory are given.

E. H. W. B.

533.6 : 621.317.39

886

The development of an automatic electric balance for research on aerodynamic stability. BRATT, J. B., AND WIGHT, K. C. *Phil. Mag.*, 35, pp. 588-600, Sept., 1944.—[Abstr. 763 B (1945)].

533.6.07 : 621.63 : 621.34

887

Three-phase variable-speed drives for wind tunnel blowers. SCHRAGE, H. K. *Brown Boveri Rev.*, 30, pp. 114-118, May-June, 1943.—[Abstr. 802 B (1945)].

533.75 : 536.633.3

888

The van der Waals constant "a" from C_p/C_v measurements. RUNDLE, R. E. *J. Amer. Chem. Soc.*, 66, pp. 1797-1798, Oct., 1944.—An equation relating a and γ is developed, and values of a obtained from it are compared with those obtained from critical data for A , H_2 , N_2 , CO_2 , N_2O , and SO_2 . The agreement is reasonably good for the first 3, but not for the others.

W. R. A.

534.01 : 532.322

889

On mechanical self-excited oscillations. MINORSKY, N. *Proc. Nat. Acad. Sci., Wash.*, 30, pp. 308-314, Oct., 1944.—A description is given of a typical phenomenon of this kind which was observed during experimental work on the anti-rolling stabilization of ships by the activated-tanks method. The principal features of the phenomenon are explained on the basis of non-linear mechanics. The necessary differential equations are set up and solved approx.

and it is found that, when a certain parameter reaches a critical value, self-excitation of a relatively high frequency sets in and superimposes itself on the normal stabilizing action.

L. S. G.

534.014.2 : 621-272.1

890

On the forced vibrations of non-linear springs. WYLIE, C. R., JR. *J. Franklin Inst.*, 236, pp. 273-284, Sept., 1943.—The paper gives a determination of the amplitude of the undamped vibrations of a mass excited by a periodic force and restrained by a spring with a non-linear elastic law. Several methods of approx. solution are compared with accurate solutions obtained by numerical integration, and one of these latter admits of a simple graphical representation in the form of 2 nomograms which give a reasonably complete numerical solution.

G. E. A.

534.115

891

Vibrations of air-columns in pipes. PATNAIK, B. B. *Bull. Calcutta Math. Soc.*, 36, pp. 79-82, June, 1944.—The pipe is open at each end and is fitted symmetrically with a number of thin movable pistons, each of the same mass and each controlled by a spring of given strength. The normal modes of vibration are given by a determinantal equation and this is shown to be equivalent to a pair of simple trigonometric equations.

L. S. G.

534.12 : 517.949

892

A general method of approximation to the influence function of an elastic system. SABEL, E. *J. Franklin Inst.*, 234, pp. 535-548, Dec., 1942.—In problems concerning the bending of plates, the influence (Green's) function is either unknown or expressed in a form unsuitable for computation. A method is given for obtaining approx. numerical values of the function directly from the differential equation and the boundary conditions without having to integrate the equation.

G. E. A.

534.121 : 621.165

893

On a generalization of Kirchhoff's theory of transverse plate vibrations in the vibration problem of steam turbine discs. MALKIN, I. *J. Franklin Inst.*, 234, pp. 355-369, Oct., and pp. 431-452, Nov., 1942.—[Abstr. 625 B (1945)].

534.3 : 781

894

Contributions of science to an appreciation of music. PEPINSKY, A. *J. Franklin Inst.*, 235, pp. 361-392, April, 1943.—The study of the acoustics of the auditorium showed how to correct, among other things, poor reception of music. Consonance and dissonance and tone quality are discussed, also the raising of the threshold of a masked sound by the action of the masking sound. The author describes an experiment in orchestration to indicate the possible effects of masking on the tone quality of one instrument in the presence of others. Instruments were chosen with simple spectra, viz. cornet, French horn, trombone, baritone and tuba. These were made to simulate the tonic of B flat major in various settings and intensities (20 db = p ; 40 = mf ; 60 = f). The cumulative effects of the instruments when sounded together were estimated by means of published data; the tuba sounded the note 58 c/s, the others 116, 290, 348 and 464 resp. [$d, d' m' s' d'' f$]. The masking effects of the partials of the separate instruments were studied in the light of data from Fletcher's graphs.

The instruments were then combined, adding one at a time, for each of the sensation levels, then each instrument in turn played solo (*f*, with others *p*). The results show that chords do not necessarily sound as they are written. In certain instances instruments might well be omitted entirely; in others the notes of a chord should be reassigned to different instruments to secure proper balance. A more extended knowledge of these effects would tell the composer and arranger what not to do, and give pause to the young creator lacking orchestra training. Organists are warned that new compositions adapted to the instrument should be used for electronic organs instead of rehashed pipe-organ music. G. E. A.

535.215 : 537.525.8 *see Abstr.* 982, 983

535.215.5 : 537.312.5 *see Abstr.* 976, 977

535.243 : 535.733 *see Abstr.* 934

535.247.4 : 612.13 895

An instrument for measuring the quantity of blood at its degree of oxygenation in the web of the hand. SQUIRE, J. R. *Clin. Sci.*, 4, pp. 331-337, Oct., 1940.—This photo-electric instrument measures the light transmitted through the web of the hand alternatively in either the red or infra-red spectral regions. It is calibrated with films of whole blood so that the web measurements can be interpreted to give the value for oxygenation in terms of percentage saturation, and for quantity of blood in terms of thickness of the whole blood. The apparatus comprises a Cs emission gas-filled type photocell sensitive to red and infra-red light; gelatin colour filters; skin clamp embodying light source (4 V torch bulb) and capsule for compressing the web; pressure reservoir and mercury manometer; a simple valve amplifier built up to contain h.t. and l.t. batteries, the latter supplying current for the light source; and a needle galvanometer.

C. J. G.

535.247.4 = 3 896

Measurement of light in light-fastness tests. KOCHERHANS, R. *Melliand Textilber.*, 24, pp. 439-441, 474-476, 1943.—The relative merits of thermo- and photo-electric methods for the measurement of spectral energy are compared. The latter is preferred, and a circuit involving the use of a high-vacuum K cell (sensitivity 3 μ A/lumen) is described. Data for measurements of natural daylight from Nov. 1941 to Oct. 1942 are tabulated and examined statistically.

J. G.

535.317 : 537.533.72 : 537.531 897

Microscopy with light, electrons and X-rays. PRESTON, G. D. *J. Sci. Instrum.*, 21, pp. 205-213, Dec., 1944.—A general survey of the principles of image formation, resolving power and magnification, the experimental arrangements and the limits of application, of the 3 methods of microscopy.

535.317 : 771.35 898

The assessment of lenses. COX, A., AND MARTIN, H. W. *J. Sci. Instrum.*, 22, pp. 5-12, Jan., 1945.—General features of the mode of image formation of photographic lenses are considered, and their influence on the qualitative and quantitative evaluation of lens performances is discussed. The constructions and performance of some representative modern types are described.

535.324 : 532.14 : 536.423.1 : 541.6 899

The silicon methoxyisocyanates. Molar refractions in carbon, silicon and germanium compounds containing isocyanate. FORBES, G. S., AND ANDERSON, H. H. *J. Amer. Chem. Soc.*, 66, pp. 1703-1706, Oct., 1944.—B.p., densities and refractive indices were measured. Molar refractions were evaluated and compared with those in the silicon chloroisocyanate series. Reaction rates of Sb fluoride with Si tetrachloride, isocyanate and bromide decreasing in this order are not inconsistent with a corresponding order of bond strengths and of electronegativities.

535.324 : 541.123.31 *see Abstr.* 1046

535.33.071 900

Variable-path-length cell for the measurement of the absorption of liquids in the infra-red region of the spectrum. GORDON, R. R., AND POWELL, H. *J. Sci. Instrum.*, 22, pp. 12-14, Jan., 1945.—The cell has a small capacity and shows excellent repeatability in setting at any given thickness. It is practically leak-proof when used with hydrocarbons and can be adjusted to a thickness of 0.004 in. with an accuracy of 1%.

535.338.4 901

A note on the spectrum of MgO. BARROW, R. F., AND CRAWFORD, D. V. *Proc. Phys. Soc., Lond.*, 57, pp. 12-15, Jan. 1945.—Observations on the spectrum of Mg burning in air were made with a grating spectrograph of dispersion $\sim 7.4 \text{ \AA/mm}$. Wavelength data are given for a weak sequence of bands with head at about 4 820 $\text{\AA}$ and of a complex system in the region 3 600-4 000 $\text{\AA}$, from measurements of plates taken in a first and second order respectively. The $\lambda 4 820$ sequence may possibly form part of the well-known green system of MgO. The stronger bands of the near ultra-violet system were photographed in absorption.

535.338.41 : 539.132 902

Resonance in precessional states of diatomic molecules. HOWELL, H. G. *Proc. Phys. Soc., Lond.*, 57, pp. 32-37, Jan., 1945.—Examples of electronic states described by van Vleck as "pure precession" are found in the Hg, Cd and Zn halide spectra and also with InO and GaO. These are shown to be in close resonance and probably have abnormally large Λ -type doubling. An interpretation of the spectra of InO and GaO is given and a potential-energy diagram is presented for these molecules and also for TlO.

535.338.42 903

The spectra of tin and lead hydrides. HOWELL, H. G. *Proc. Phys. Soc., Lond.*, 57, pp. 37-45, Jan., 1945.—It is shown that the 2I ground-state doubling of SnH is due to a pn electron, and its magnitude can be predicted from the $2P$ width of the Sn ground state. The same doublet separation is found among the red bands of SnH, and a vibrational analysis is presented for this system, which is considered to be a $2\Sigma - 2\text{I}$. It is assumed that PbH will also have a 2I ground state with an estimated separation of 8 200 cm^{-1} and which is modified by case-c coupling. Although this interval is actually found among the PbH bands, its occurrence is not taken as proof of the existence of the 2I ground state, as it appears to be more likely the separation of two excited states. The red system analysed by Watson and Simon and described by them

as $2\Sigma - 2\Sigma$ is here interpreted as a $\frac{1}{2}(2\Sigma) - \frac{1}{2}(2\Pi)$ system analogous to the $\text{SnH } 2\Sigma - 2\Pi$ system, and an isolated band at $3815 \text{ \AA}$ is considered to be the $0,0$ band of $\frac{3}{2}(2\Delta) - \frac{1}{2}(2\Pi)$. It is explained why the main band system has the appearance of a $2\Sigma - 2\Sigma$ system and why the spectra of SnH and PbH are apparently so dissimilar. The occurrence of two GeH systems is predicted. A similarity between the hydrides and halides of this carbon group is described and a number of 2Π separations for the ground states of these molecules is predicted.

535.343; 535.372

904

The light absorption and fluorescence of triaryl-methyl free radicals. LEWIS, G. N., LIPKIN, D., AND MAGEL, T. T. *J. Amer. Chem. Soc.*, 66, pp. 1579-1583, Sept., 1944.—An investigation of the absorption and fluorescence spectra of Ph_3C at low temperature and high dispersion reveals that the subsidiary bands are surprisingly complex and well resolved, and that a remarkably exact mutual reflection of absorption and fluorescence is encountered. A similarly complex absorption spectrum is found when 1, 2, or 3 of the *para* H atoms are replaced by *tert*-Bu groups. *o*-tolylidiphenylmethyl has an absorption curve nearly identical with that of Ph_3C , and so has 9-phenylfluorenyl. The absorption spectra and some other properties of α -naphthylidiphenylmethyl and tri-*p*-xenylmethyl (a blue substance changing irreversibly on standing to a red substance) were investigated. The absorption spectra of tri(*p*-nitrophenyl)-bromomethane, prepared by the direct action of Br on the corresponding methane, were examined at different temperatures, and the reported change in colour with temperature confirmed. Details of the preparation of triaryl-methyls from the corresponding halides by reduction with Ag or Ti amalgam are given.

W. R. A.

535.343; 535.372; 535.375.5

905

The light absorption and fluorescence of triaryl-methyl free radicals. PAULING, L. *J. Amer. Chem. Soc.*, 66, p. 1985, Nov., 1944.

535.343; 537.531 see Abstr. 984

535.343; 541.651

906

Absorption spectra of some linear conjugated systems. FERGUSON, L. N., AND BRANCH, G. E. K. *J. Amer. Chem. Soc.*, 66, pp. 1467-1475, Sept., 1944.—Spectra of conjugate imino aromatic compounds, many belonging to vinylenic homologous series, were obtained. These homologous series show certain bands which appear to be related to each other, and the ways in which the values of λ_{max} vary with the number of $\text{CH} : \text{CH}$ groups are discussed and compared with the variation of λ_{max} for the diphenylpolyenes and for some similarly conjugated homologous series containing a $\text{C} : \text{O}$ group. A reduction of the effect of the conjugate system beyond the first N atom is observed in diphenylpolyeneazines. Interpolation of $\text{CH}_2 : \text{CH}_2$ between two benzalimino groups completely insulates the groups; some insulation results from the interpolation of a C_6H_6 ring so that the benzalimino groups are *meta* or *para* to each other, and this insulation increases as the number of ethylene groups in the system is increased. The expected auxochromic effects of *para* OH groups

was observed, but in the *ortho* position the OH groups show anomalous effects.

W. R. A.

535.343; 591.111 = 6

907

The absorption spectrum of blood plasma and its stability with various agents. RODRIGUEZ, A. E., AND BALSEIRO, J. A. *Publ. Fac. Cienc. Fis-Mat. La Plata*, 3, pp. 77-91, July, 1944.—An experimental determination is made of the absorption spectrum, from red to ultra-violet, of human plasma solution and that of the rabbit. The experiments indicate great stability of the spectrum with the action of toxic gases and at elevated temperatures. Further tests show that the absorption is to be attributed to the globule component.

R. M.

535.343-1

908

The infra-red spectra of furan and thiophen. THOMPSON, H. W., AND TEMPLE, R. B. *Trans. Faraday Soc.*, 41, pp. 27-34, Jan., 1945.—The infra-red spectra of furan and thiophen were measured and compared with the Raman spectra. Selection rules, band contours, and other considerations were used in attempting to assign values to the molecular vibration frequencies. Attention has been drawn to some misinterpretations of earlier data with furan. These two molecules appear to have a planar structure in the symmetry class C_{2v} .

535.343-31

909

The ultra-violet absorption spectra of hydrocarbon-trinitrobenzene complexes. JONES, R. C., AND NEUWORTH, M. B. *J. Amer. Chem. Soc.*, 66, pp. 1497-1499, Sept., 1944.—Complexes of trinitrobenzene with naphthalene, phenanthrene, anthracene, pyrene, chrysene, 1:2-benzopyrene, and 1:2:5:6-dibenzanthracene are shown, by studying their ultra-violet absorption spectra in dilute MeOH solution, to be completely dissociated. The concept of complete dissociation and the additivity of spectra are applied to representative two-, three-, four-, and five-ring hydrocarbons, and the application of this concept as an identification tool is indicated.

W. R. A.

535.343-31

910

Characterization of the ultraviolet absorption spectra of some substituted benzenesulphonamides. VANDENBELT, J. M., AND DOUB, L. *J. Amer. Chem. Soc.*, 66, pp. 1633-1636, Oct., 1944.—The ultraviolet absorption spectra of several substituted benzenesulphonamides were examined with the Beckman spectrophotometer and, in particular, the changes in the band with change in pH. By comparison with the behaviour of the bands in simpler molecules, it is possible to associate particular bands with certain groups in the molecule.

W. R. A.

535.343-31; 537.561

911

The absorption spectra of the chloroethylenes in the vacuum ultra-violet. WALSH, A. D. *Trans. Faraday Soc.*, 41, pp. 35-45, Jan., 1945.—The spectra of vinyl chloride, *cis* and *trans* dichloroethylene, trichloroethylene and tetrachloroethylene were photographed. Well-developed Rydberg series were found for the first ionization potentials of the first 3 of these molecules. The limits are 9.95 V (vinyl chloride); 9.61 V (*cis* dichloroethylene); and 9.91 V (*trans* dichloroethylene). A possible Rydberg series with a limit at 8.8 V is indicated for trichloroethylene. These

onization potentials are all due to the excitation of one of the π electrons of the double bond. The spectra as a whole show the importance of the conjugation of the $p\pi$ non-bonding lone pair electrons on the chlorine atoms with the π electrons of the $C=C$ bond.

535.345 : 535.434 : 535.668 see *Abstr.* 929

535.345 : 535.61-291 912

Instrumentation studies XLVIII. Instruments for the measurement of opacity of paper. II. Calibration of the Bausch and Lomb opacimeter. Paper Tr. J., 119, pp. 27, 28, and 30, Oct. 26, 1944.—Errors involved when the white backing body used in the TAPPI standard opacity test is a permanent standard in direct contact with, and separated by a cover glass from, the paper specimen, are discussed. They are enhanced in the latter case. A procedure for adjusting the abs. reflectance of the white backing body to 0.89 under the conditions of actual measurement is given. Detailed technique is described for the preparation of a standard white, by depositing a standard thickness of MgO (from burning Mg) on a flat surfaced block of $MgCO_3$. Such standards do not retain a const. reflectance, and should be scraped and resurfaced before re-use. J. G.

535.37 913

Crystal luminescence—paramagnetic ions as centres. THOSAR, B. V. J. Chem. Phys., 12, p. 424, Oct., 1944.

535.371 : 535.51 914

On the polarized fluorescence—dyestuffs in solution. CHOUDHURI, K. Indian J. Phys., 18, pp. 74-83, April, 1944.—The variation of the polarization with wavelength of radiation was investigated. The polarization decreases with increase in wavelength, reaches a negative value and then increases again. The negative value occurs at wavelengths characteristic for the molecules of the dyestuff. A comparison of the polarization curves and absorption curves was made. The variation of the polarization with change of viscosity of the solution, temperature of the solution and conc. of the dyestuff, was investigated. The degree of polarization tends to vanish asymptotically at low viscosities or at high temperatures or at high conc. of the dyestuffs, while it tends asymptotically to a max. value at very high viscosities or low temperatures or at very low conc. For a particular solvent, this max. is dependent on the nature of the dyestuff and the wavelength of the exciting radiation.

535.371 : 621.327.43 915

The magnesium tungstate phosphor. FONDA, G. R. J. Phys. Chem., 48, pp. 303-307, Sept., 1944.—The phosphor exhibits the monoclinic structure of $MgWO_4$, even in the presence of an excess of MgO which, at a conc. $\rightarrow 1$ mole, gives a notable increase in fluorescence brightness. When fired for a long period at $1250^\circ C$, it loses its fluorescence in one of two ways, depending upon the conc. of MgO : (a) by conversion into a semi-glassy state, if it contains 0.5 mole or less of excess MgO ; (b) by alteration into another crystalline modification, having presumably the formula Mg_2WO_5 , if it contains 1 mole or less of excess MgO . Mg_2WO_5 differs from $MgWO_4$ not only in being non-fluorescent but also in being stable only above $1200^\circ C$. and in having a m.p. above

$1460^\circ C$. The quantum efficiency of excitation of the phosphor is $\rightarrow 1$ for $2500\text{--}2950 \text{ \AA}$.

535.372 916

On the occurrence of a fluorescing polyene with a characteristic spectrum. ZECHMEISTER, L., AND POLGÁR, A. Science, 100, pp. 317-318, Oct. 6, 1944.

535.372 : 535.343 see *Abstr.* 904

535.372 : 535.375.5 : 535.343 see *Abstr.* 905

535.375.5 917

Raman spectra of some disubstituted diacetylenes. MEISTER, A. G., AND CLEVELAND, F. F. J. Chem. Phys., 12, pp. 393-398, Oct., 1944.—Raman frequencies and relative intensities are reported for dimethyldiacetylene, diethyldiacetylene, dipropyldiacetylene, dibutyldiacetylene, and diamyldiacetylene. Depolarization factors were obtained except for diethyldiacetylene. A tentative assignment was made of all the observed Raman frequencies of dimethyldiacetylene, assuming that it has the symmetry D_{3h} . Using the chain and methyl-group frequencies thus established for dimethyldiacetylene, a comparison was made with the other spectra in order to determine how these frequencies are affected by introducing additional CH_2 groups into the dimethyldiacetylene molecule. A comparison was made of the Raman spectra of the disubstituted diacetylenes with those of the corresponding acetylenes. For dimethyldiacetylene, 3 cases of Fermi resonance occurred, but there were 2 cases where only a single line was observed. The C-C triple-bond frequency, which appears at 2183 cm^{-1} for diacetylene, increases to 2264 for dimethyldiacetylene, then drops to $2251\text{--}2257$ for the other 4 compounds.

535.375.5 : 535.372 : 535.343 see *Abstr.* 905

535.376 : 553.621 : 539.169 see *Abstr.* 1004

535.43 : 77.011 918

Note on specular densities and forward scattering. URBACH, F. J. Opt. Soc. Amer., 34, pp. 592-594, Oct., 1944.—A theoretical treatment of experimental procedure and results described by Pitt [*Abstr.* 3230 (1938)] for the relation between specularly transmitted and scattered light in the measurement of photographic densities. It is shown that a simple assumption leads to theoretical values in good agreement with Pitt's experiments and it is concluded that, quite generally, the forward scattering of an absorbing and slightly scattering layer reaches a max. when the fraction of the incident beam which is transmitted specularly, is just equal to e^{-1} . J. W. T. W.

535.434 : 535.345 : 535.668 see *Abstr.* 929

535.51 : 535.371 see *Abstr.* 914

535.511 : 522.612 see *Abstr.* 798

535.514.2 919

The polarizing angle for reflection at the boundary between two absorbing media. PINCHERLE, L. Proc. Phys. Soc. Lond., 57, pp. 56-60, Jan., 1945.—The condition for the absence of a reflected wave when a plane (inhomogenous) electromagnetic wave is incident upon the plane boundary between two absorbing media is $\cot \phi_1 \cot \psi_2 + \cot \psi_1 \cot \phi_2 = 2$, ϕ_1, ψ_1 being the angles that the planes of equal phase and the planes of equal amplitude respectively make

with the boundary. For small values of the conductivities, no reflection is obtained at the following angles: $\tan \phi_1 = \sqrt{E}$, $\tan \phi_2 = 1/\sqrt{E}$

$$\tan \psi_1 = \left(1 + E \frac{\eta_1}{\eta_2}\right) / \sqrt{E} \left[2 + \frac{1}{E} \frac{\eta_1}{\eta_2} - 1\right]$$

$$\tan \psi_2 = \left(1 + E \frac{\eta_1}{\eta_2}\right) / \sqrt{E} \left(E + 2 - \frac{\eta_1}{\eta_2}\right)$$

where $E = \epsilon_2/\epsilon_1$, $\eta_1 = \sigma_1/\omega\epsilon_1$, $\eta_2 = \sigma_2/\omega\epsilon_2$ and ϵ is the permittivity, σ the conductivity and ω is $2\pi \times$ frequency.

535.515

920

The optical anisotropy of cellulose film. GRAY, R. C. *J. Soc. Chem. Ind., Lond.*, 63, pp. 241-245, Aug., 1944.—The birefringence of cellulose film is influenced by the pressure in the viscose at the moment of extrusion, by the rate of coagulation, and by the machine direction forces and the transverse frictional forces exerted on the film during the casting process; the relative retardation is unaffected by change of water content, but since increase of water content causes increase of thickness, it causes a corresponding reduction in birefringence. The birefringence has as min. value B_0 at the middle of the web, and rises towards the selvages in accordance with the law $B = B_0 + bx^4$, where x is the distance from the middle of the web, and b is a positive const. that depends on the transverse forces acting on the film during contraction. The dispersion of the birefringence follows the law $B = a - b/\lambda^2 + c/\lambda^4$, where a , b , c are positive const.; B has a min. value in the extreme red. For the same grade of film, the tensile strength in the machine direction, and in the transverse direction, is greater when the birefringence is greater. Stress in the machine direction can increase the permanent birefringence by 50%. Stress in the transverse direction can reduce the permanent birefringence to zero, and can reverse its sign; the final birefringence may be numerically as great as the initial birefringence. All commercial dyed cellulose films are dichroic, the effect being most pronounced in the chocolates and mauves.

535.515

921

Studies on double refraction of flow. I. An apparatus for the study of double refraction of flow at high velocity gradients. EDSALL, J. T., GORDON, C. G., MEHL, J. W., SCHEINBERG, H., AND MANN, D. W. *Rev. Sci. Instrum.*, 15, pp. 243-252, Oct., 1944.—Observation in polarized light of a liquid moving between concentric cylinders, with a velocity gradient produced by rotation of one cylinder, permits determination of orientation of asymmetric molecules in the liquid. An apparatus with a gap of 0.25 mm. between inner and outer cylinder is described; the inner, rotating cylinder is maintained concentric with the outer cylinder at 3 000 r.p.m. or more, by a system of preloaded bearings. The cylinders are driven by a motor-generator system. Speed of rotation is determined stroboscopically. The optical system is described, together with the methods for determining the orientation of the optic axis in the liquid, and the magnitude of the double refraction.

535.515 : 532.785 : 541.182.6 see Abstr. 1106

535.551 : 620.171.5

922

Optical aspects of three-dimensional photo-elasticity. MINDLIN, R. D. *J. Franklin Inst.*, 233, pp. 349-363, April, 1942.—There is now developing a technique for optically analysing 3-dimensional stress systems. A model is made from a hardening resin [see Abstr. 2325 (1939)]; the resulting material is doubly refracting and its optical properties are apparently unchanged when cut into thin slices. It is therefore possible to determine the stress distribution in the entire specimen from the optical properties of the slices. These in general represent a stress distribution involving both normal and shearing stresses on the plane of the slice, and in this respect it is different from plates employed in 2-dimensional work. The wave velocities and directions of polarization are described in terms of Fresnel's ellipsoid, and possible methods of measuring the indices of refraction are given.

G. E. A.

535.61-291 : 535.345 see Abstr. 912

535.646

923

On the geometry of colour space. MACADAM, D. L. *J. Franklin Inst.*, 238, pp. 195-210, Sept., 1944.—Describes the construction and use of a chromaticity diagram and includes a diagram showing the limits of the chromaticities possible for surfaces of different reflection factors illuminated with C.I.E. illuminant C. A colour plate shows the distribution and limits of the colours obtainable with modern colour printing. A diagram is given to illustrate the variations in perceptible chromaticity difference at different points in the diagram. The author points out the objections to some work on this subject by Moon and Spencer [Abstr. 2333 (1943)].

J. W. T. W.

535.646

924

Geometry of colour space. SPENCER, D. E. *J. Franklin Inst.*, 236, pp. 293-302, Sept., 1943.—Describes the way in which colours are specified and represented in a colour space. A Euclidean metric has been found which will represent colour tolerances simply so that any pair of just perceptibly different colours are separated by the same distance in all parts of the space. The effect of surroundings on the appearance of a colour is also considered. J. W. T. W.

535.653

925

A simple form of the Nagel anomaloscope. SHAXBY, J. H. *J. Sci. Instrum.*, 22, pp. 15-16, Jan., 1945.—The scattering of light by a turbid medium is used to obtain the mixture of 2 colours required to match a given colour. Light is passed through juxtaposed coloured filters to fall on a slab of Diffusalyte glass, the scattered mixed light emerging from the edge of the slab. A second slab is similarly illuminated by light of the colour to be matched, and the two adjacent fields varied by suitable slides, the first in colour, the second in brightness, until they match.

535.66 : 576.72

926

Studies in relative differentiation of tissues by means of filtered ultra-violet light. HERLY, L. *Cancer Res.*, 4, pp. 227-231, April, 1944.—This study was undertaken to determine whether specificity of colour could be correlated to specific tissues. Pfaltz and Bauer and Hanovia lamps were used interchangeably with filters permitting passage of ultra-violet light (max. intensity approx. 3 700 Å). The results are discussed.

The photographic reproductions of the colours obtained in tissues under filtered ultra-violet light have not so far been true reproductions of those seen by the eye.

C. J. G.

535.66 : 667.21

927

The brightness of present-day dyes. VICKERSTAFF, F. *Proc. Phys. Soc., Lond.*, 57, pp. 15–37, Jan., 1945.—Examines methods for expressing the performance of any actual dye in terms of that of the ideal dye having the same dominant wavelength. Measurements on the dye are converted into psychological units by means of the recently published data on the Munsell system, and the scope for improvement, i.e. the deficiency, is expressed in terms of the number of steps of chroma between the actual dye and the ideal.

J. W. T. W.

535.662 : 675.6 = 3

928

On the use of the natural pigments of fur hairs in the improvement of furs. GINZEL, A. *Melliand Textilber.*, 24, pp. 438–439, 1943.—The subtle colour effects on many furs arise from the zones of colour present on the constituent hairs, which produce the effect of one colour against a background of one or more other colours. Examples are described, and it is shown how modification of one or more of these zones on the hairs of rabbit skins (e.g. by bleaching or by treatment with reagents or other colours) may be used to simulate more expensive furs (e.g. silver fox or American opossum).

J. G.

535.668 : 535.345 : 535.434

929

Evaluating the opacifying properties of pigments. ADRIAN, A. P. *Paper, Tr. J.*, 119, *TAPPI Sect.*, pp. 149–155, Oct. 12, 1944.—A dilute suspension of the pigment in water is stirred well in a high-speed malted-milk mixer and introduced into the bowl of a Sharples super-centrifuge rotating at 16 000–17 000 r.p.m. The bowl is previously lined with a film of ethyl cellulose, and the suspension is fed in through the base from a height of 7 ft. using a glass funnel and rubber tube attached to a $1/16$ in. injection tube. A pigment film is deposited on the backing, and may be removed with it and tested for opacity by the contrast-ratio method. The use of the Kubelka and Munk equation for this purpose is described. Reproducible results were obtained with the G.E.C. recording spectrophotometer for the specific scattering coeff. and the specific absorption coeff. The method is suitable for measurements of the influence of the compacting of pigment particles, of particle size, and of the presence of mixtures of pigments on the light-scattering properties of pigment films.

J. G.

535.7

930

The physical and photochemical basis of visual resolving power. I. The distribution of illumination in retinal images. BYRAM, G. M. *J. Opt. Soc. Amer.*, 34, pp. 571–591, Oct., 1944.—The visibility of distant objects seen through haze depends on (a) the effect of the haze in reducing contrast and (b) the relation between visual acuity and brightness contrast. This paper deals with images of small objects, especially a line, a disc and a grating of parallel lines. The purely physical determination of the illumination distribution, when compared with experimental determinations of visual acuity, leads to the conclusion that a satisfactory theory of visual acuity

must take account of the photochemical aspects of the subject and these are to be discussed in a later paper.

J. W. T. W.

535.7

931

The relative merits of red and white light of low intensity for adapting the eyes to darkness. ROWLAND, W. M., AND SLOAN, L. L. *J. Opt. Soc. Amer.*, 34, pp. 601–604, Oct., 1944.—Some experiments on the rate of dark-adaptation after exposure to red and to white light are described. With rod vision, the rates are approx. equal for 58 millilamberts of red and 1.5 ml. of white.

J. W. T. W.

535.7 : 612.84

932

Figural after-effects. KÖHLER, W., AND WALLACH, H. *Proc. Amer. Phil. Soc.*, 88, 4, pp. 269–357, 1944.—A description of the phenomena relating to the distortion which takes place in after-images and a suggested explanation in terms of the visual process.

J. W. T. W.

535.7 : 628.9

933

Visual data applied to lighting design. MOON, P., AND SPENCER, D. E. *J. Opt. Soc. Amer.*, 34, pp. 605–618, Oct., 1944.—Summarizes the available data on (a) contrast sensitivity and (b) visual acuity, and derives expressions to represent the relation between these quantities and brightness. The practical conclusions to be drawn from the data and from the form of the S-curves used for determining the threshold values are discussed. The illumination required for adequate vision in any given circumstances increases as “adequacy” is taken to mean a higher percentage of the best performance obtainable in the limit.

J. W. T. W.

535.733 : 535.243

934

Eastman colour-temperature meter used as an anomaloscope. SLOAN, L. L. *J. Opt. Soc. Amer.*, 34, pp. 618–620, Oct., 1944.—In the Eastman colour-temp. meter, a match is made between the light passing through a filter with max. transmission at $580\text{ m}\mu$ and the mixture of lights passing two other filters with max. at 520 and $680\text{ m}\mu$ resp. The instrument may be used as an anomaloscope by employing a constant light source and determining the proportions of red and green needed by an individual to give a colour match. Some results obtained in this way are compared with those given by other colour-deficiency tests.

J. W. T. W.

535.733.1

935

The Stiles–Crawford effect and the design of telescopes. JACOBS, D. H. *J. Opt. Soc. Amer.*, 34, p. 694, Nov., 1944.—[See Abstr. 2427 (1944)].

536.2

936

Heating and cooling times in circulating systems. FISHER, R. C. *Industr. Engng Chem.*, 36, pp. 939–942, Oct., 1944.—Equations are derived and methods given for making calculations relating to the heating of tanks of fluid and the quenching of ingots. The simplifying assumptions made are, that the ingot and fluid are each at uniform temperatures, that there is no external heat interchange, and that no change of state is involved. Examples evaluated include, time for tank to be heated by l.p. steam, and times for ingot to cool through a specified temperature interval

(a) with cooling fluid circulated through external cooler of given capacity, (b) with no external circulation.

R. W. P.

536.2 : 676.2.05

937

Study of the dissipation of the frictional heat in the mechanical process. JAEGER, J. C., AND SOMERVILLE, J. L. *Paper Tr. J.*, 119, *TAPPI Sect.*, pp. 99-104, Sept. 14, 1944.—The cyclic changes in temperature of any point on the grinding surface of a groundwood grindstone during a complete revolution are obtained approximately by the mathematical analysis of a simplified case, taking into consideration the conduction of heat into the wood, the cooling of the stone by the top shower and by the stock in the pit, and the water carried into the grinding areas by the grooves in the surface of the stone. Normally the working temperature of the stone is higher than that of the stock in the pit, and the difference is an indication of the cooling effect of the grinding interface; water is always present at this interface as a continuous film. The temperature of the surfaces under abnormal operating conditions is discussed. J. G.

536.21

938

The influence of through-metal on the heat loss from insulated walls. PASCHKIS, V., AND HEISLER, M. P. *Trans. Amer. Soc. Mech. Engrs*, 66, pp. 653-663, Nov., 1944.—The heat flow can be considerably larger than would be found from adding to the heat flow through the insulation that contributed by the through-metal, as if the two were independent. Thus the apparent effectiveness of an insulation can be very much smaller than would be calculated from the thermal conductivity alone. General curves are developed and their application explained, from which an increase factor for any condition (conductivity and thickness of the insulation, conductivity and thickness of the strips, outside film conductance) can be read. The increase factor is the ratio of the heat flow through an actual structure, to the flow that would occur if the insulation and heat flow through metal strips were independent of each other.

536.21

939

A problem of heat conduction with spherical symmetry. BELL, R. P. *Proc. Phys. Soc., Lond.*, 57, pp. 45-48, Jan., 1945.—Arising from the problem of the heating of a body placed at the centre of a furnace, solutions are given for the conduction of heat through concentric spheres of radii a and b . The two extreme cases where the outer annular sphere has initial temperatures equal to v_0 , the temperature of the inner sphere, and to zero, the temperature of its own surroundings, are solved. The former case has been treated by Carslaw [Abstr. 932 (1922)] and an error in a section of this work is disclosed. Simplified equations are given for certain practical cases, particularly as the later stages are approached. The equation $v_1 = v_0 \exp. \left\{ -\frac{3\sigma}{\mu} \cdot \frac{b}{a^2(b-a)} k_2 t \right\}$ can then often be used and can also be used as an approximation for non-spherical systems if average values of $b/a^2(b-a)$ are taken: $\sigma = K_2/K_1\mu$, $\mu = (k_2/k_1)^{1/2}$, k_1 , k_2 = diffusivities and K_1 , K_2 thermal conductivities, v_1 and v_0 = temperatures of inner and outer spheres. R. W. P.

536.222

940

Thermal conductivity of water. SOONAWALA, M. F. *Indian J. Phys.*, 18, pp. 71-73, April, 1944.—The conductivity is determined by the periodic-flow method of Ångström. A mean value of 0.00146 is obtained.

536.245 : 621.181.5

941

Temperature distribution within boiler tubing under oblique radiation. KIMBALL, W. S. *Trans. Amer. Soc. Mech. Engrs*, 66, pp. 697-703, Nov., 1944.—[Abstr. 628 B (1945)].

536.41

942

The thermal expansion of metals at low temperatures. DAYAL, B. *Proc. Indian Acad. Sci. A*, 20, pp. 192-199, Oct., 1944.—The experimental data on Al, Ag, Cu, Au, Pb (face-centred metals), W, Li, Na (body-centred metals), and Si were examined from the standpoint of the Grüneisen theory. Face-centred metals obey the law of Grüneisen, but body-centred metals do not. Data on Si are inadequate to allow of conclusions. A tentative explanation of the breakdown in the theory as applied to body-centred metals is advanced. W. R. A.

536.41.01 : 548.0 : 549.211

943

The theory of the thermal expansion of diamond. DAYAL, B. *Proc. Indian Acad. Sci. A*, 20, pp. 187-191, Oct., 1944.—By a modification of the Grüneisen formula for the force between the atoms, the constants of the 8 vibration frequencies of diamond given by the Raman dynamics of crystal lattices are evaluated, assuming that the force constant of the angular distortion does not change with change in volume. The thermal expansion of diamond is calculated and the values agree with experimental data. The observed change of the Raman line of diamond with temperature is quantitatively explained. Derived values for the heat of vaporization of diamond agree with other computed values. W. R. A.

536.412

944

Thermal density coefficients and hydrometer correction tables for vegetable tanning extracts. BLAIR, M. G., AND PEPPER, E. L. *J. Res. Nat. Bur. Stand., Wash.*, 33, pp. 341-352, Nov., 1944.—Densities and thermal expansions were determined of quebracho, oak bark, hemlock bark, chestnut, and mangrove bark, within the range 1.00 to 1.12 sp.g. at 60°/60°F. and from 50° to 100°F. The information was used in the preparation of tables for correcting hydrometer readings at observed temperatures in deg. barkometer, in deg. Twaddle, and in deg. Baumé to readings at the standard temperature 60°F.

536.421

945

Hexamethylethane. CALINGAERT, G., SOROOS, H., HNZIDA, V., AND SHAPIRO, H. *J. Amer. Chem. Soc.*, 66, pp. 1389-1394, Aug., 1944.—The value obtained for the f.p. of hexamethylethane is lower than the best values reported by others. This is probably attributable to the difference in methods used. M.p. values for this hydrocarbon obtained by determinations in capillary tubes without stirring are likely to be high and show a melting range, unless the temperature of the bath is raised at a very slow rate. In order to obtain by the capillary-tube method the value observed by the freezing-curve method, it was

necessary to increase the temperature of the bath at rate not greater than 0.1° per 4 min.

36.423 : 532.62 see *Abstr.* 871

36.423 : 536.7

946

Correlating vapour compositions and related properties of solutions. OTHMER, D. F., AND GILMONT, R. *Industr. Engng Chem.*, 36, pp. 858-865, Sept., 1944.—Vapour compositions, equilibrium constants, activity coefficients, and relative volatilities as functions of pressure and temperature, are plotted directly to give straight lines [Abstr. 2491 (1940)]. A min. of data may thus be used to define a whole system, and the consistency of experimental data may be evaluated. A new and simpler plot and the corresponding equations are presented for partial pressures, vapour compositions, equilibrium constants, activities, and relative volatilities as direct logarithmic functions of the total pressure of the system.

36.423.1 : 541.123.2 see *Abstr.* 1042

36.423.1 : 541.6 : 532.14 : 535.324 see *Abstr.* 899

36.423.15 : 541.132 : 532.713 see *Abstr.* 880

36.423.8 : 532.62

947

Rates of evaporation of water through compressed monolayers of water. LANGMUIR, I., AND SCHAEFER, W. J. *J. Franklin Inst.*, 235, pp. 119-162, Feb., 1943.—The rate of evaporation of H_2O from a clean surface and from one covered by a compressed monolayer was measured by finding the increase in wt. of a vessel of $CaCl_2$ at a known distance above the surface. The rate of escape of H_2O mols was decreased in the ratio of $\sim 10^4 : 1$ by a monolayer of cetyl alcohol. By analogy with Ohm's law, the evaporation resistance, w_f , is given by rate = driving-force/resistance, and increases rapidly with the surface pressure w_f of monolayers of fatty acids with a large number of C atoms, and the effect of pH of the substrate and the presence of Ca and Ba salts were investigated. There is a linear relationship between surface pressure, F , and $\log w_f$. Collapse pressures for the films are much higher for acids having an odd number of C atoms. The F/w_f curves show a hysteresis effect. Minute amounts of impurities can have a great effect on w_f . The effects of thick layers of oil on the rate of evaporation of H_2O were investigated. Results are discussed theoretically.

N. M. B.

[536.46 + 536.58 + 531.787] : 669.18 see *Abstr.* 1169

536.468 : 679.5 see *Abstr.* 1171

536.48 : 669.143.1 : 621.785

-948

Sub-zero treatment of steel. AMTSBERG, H. C. *Machinery*, N.Y., pp. 137-144, Oct., 1944.—[Abstr. 925 B (1945)].

536.531 : 621.317.39.083.7

949

A unique moving-magnet ratio instrument. SIAS, F. R., AND FISK, D. B. *Trans. Amer. Inst. Elect. Engrs*, 63, pp. 634-636, Sept., 1944.—[Abstr. 770 B (1945)].

536.531.089.6 : 621.317.39

950

Controlling quality of resistance-thermometer bulbs. FRANCK, R. E. *Gen. Elect. Rev.*, 47, pp. 42-47, Nov., 1944.—[Abstr. 768 B (1945)].

[536.58 + 531.787 + 536.46] : 669.18 see *Abstr.* 1169

536.581 : 531.224.4 see *Abstr.* 844

536.6/7

951

Thermodynamics of gaseous paraffins. Specific heat and related properties. PITZER, K. S. *Industr. Engng Chem.*, 36, pp. 829-831 Sept., 1944.—Available experimental gas specific-heat values for the normal paraffins are in excellent agreement with curves calculated by methods previously published by the writer. Certain parameters in these calculations are revised on the basis of recent spectroscopic studies. Calculated entropies are still in excellent agreement with measured values. The corresponding results for heat content and the free-energy function are also presented. The data for branched paraffins are too meagre to allow generalizations except that the change in specific heat with isomerization is small. Entropy differences calculated previously have been confirmed, in so far as additional data are available.

536.62

952

Heating value of natural gas. HEADLEE, A. J. W., AND HALL, J. L. *Industr. Engng Chem.*, 36, pp. 953-955, Oct., 1944.—The total (THV) and net (NHV) heating values of natural gas are related by the empirical equation:

$$THV - 1.072 NHV = 34 - 0.34 I$$

This equation is used to check the accuracy of the corrections for the water of combustion of a water-flow gas calorimeter.

536.62 : 536.75

953

The heat capacity of potassium dihydrogen phosphate from 15° to $300^\circ K$. The anomaly at the Curie temperature. STEPHENSON, C. C., AND HOOLEY, J. G. *J. Amer. Chem. Soc.*, 66, pp. 1397-1401, Aug., 1944.—Measurements of C_p of crystalline KH_2PO_4 were made from 15° to $300^\circ K$, using the Hicks low-temperature calorimeter [Abstr. 2924 (1938)]. A max. occurs at $121.97^\circ \pm 0.05^\circ K$. The heat of transition is 87 ± 6 g.cal./mol. The entropy change associated with the anomalous portion of the curve is 0.74 ± 0.06 g.cal./deg./mol, in agreement with the value of 0.81 calculated on the assumption that rearrangement of H-bonds in the crystals is responsible for the transition. The entropy of crystalline KH_2PO_4 at $298.19^\circ K$ is 32.23 ± 0.1 g.cal./deg./mol. W. R. A.

536.62 : 536.75

954

The heat capacity of KH_2AsO_4 from 15° to $300^\circ K$. The anomaly at the Curie temperature. STEPHENSON, C. C., AND ZETTEMAYER, A. C. *J. Amer. Chem. Soc.*, 66, pp. 1402-1405, Aug., 1944.—Values of C_p for KH_2AsO_4 from 15° to $300^\circ K$ were measured [Abstr. 2924 (1938)]. A max. appears at $95.57^\circ \pm 0.05^\circ K$. The heat of transition is 84 ± 4 g.cal./mol and the entropy change 0.90 ± 0.05 g.cal./deg./mol, supporting the H-bond theory of transitions in crystals of this type. The entropy of crystalline KH_2AsO_4 at $298.19^\circ K$ is 37.08 ± 0.1 g.cal./deg./mol. W. R. A.

536.62 : 536.75

955

The heat capacity of ammonium dihydrogen phosphate from 15° to $300^\circ K$. The anomaly at the Curie temperature. STEPHENSON, C. C., AND ZETTEMAYER, A. C. *J. Amer. Chem. Soc.*, 66, pp. 1405-1408, Aug., 1944.—Measurements of C_p of crystalline $(NH_4)_2H_2PO_4$ from 15° to $300^\circ K$, made with an improved Hicks low-temperature calorimeter [see Abstr. 2924 (1938)], reveal a max. at $148.9^\circ K$. on

warming and 147.0°K. on cooling. The heat of transition $\approx 154 \pm 5$ g.cal./mol. and the entropy of transition 1.05 ± 0.04 g.cal./deg./mol. of which 0.81 is attributed to a rearrangement of H-bonds and the remainder to the crystal lattice. The entropy of crystalline $(\text{NH}_4)_2\text{PO}_4$ at 298.19°K. is 36.32 ± 0.1 g.cal./deg./mol. W. R. A.

536.62 : 536.75

956

The heat capacity of ammonium dihydrogen arsenate from 15° to 300°K. The anomaly at the Curie temperature. STEPHENSON, C. C., AND ADAMS, H. E. *J. Amer. Chem. Soc.*, 66, pp. 1409-1412, Aug., 1944.—The C_p curve of $(\text{NH}_4)_2\text{AsO}_4$, measured from 15° to 300°K., with the Hicks low-temperature calorimeter [Abstr. 2924 (1938)], shows a max. at $216.1^\circ \pm 0.5^\circ\text{K}$. The heat of transition is 220 ± 15 g.cal./mol. and the corresponding entropy change is 1.02 ± 0.07 g.cal./deg./mol. The transition is attributed to a rearrangement of H-bonds in the crystal. The entropy of crystalline $(\text{NH}_4)_2\text{AsO}_4$ at 298.19°K. is 41.12 ± 0.10 g.cal./deg./mol.

W. R. A.

536.62 : 536.75

957

The heat capacity of silver trihydrogen periodate from 15° to 300°K. The anomaly at the Curie temperature. STEPHENSON, C. C., AND ADAMS, H. E. *J. Amer. Chem. Soc.*, 66, pp. 1412-1416, Aug., 1944.—The C_p curve for $\text{Ag}_2\text{H}_3\text{IO}_6$, measured from 15° to 300°K. with a Blue-Hicks cryostat [Abstr. 5388 (1937)] and Stout-Adams calorimeter [Abstr. 2874 (1942)], exhibits between 180° and 270° a region of abnormally high C_p values with max. at $227.25 \pm 0.20^\circ\text{K}$. The change in heat content for this non-isothermal transition is 358.1 ± 20.0 g.cal./mol. and the corresponding entropy change is 1.60 ± 0.10 g.cal./deg./mol. in agreement with the value calculated on the basis of the H-bond theory of such transitions. The entropy of crystalline $\text{Ag}_2\text{H}_3\text{IO}_6$ at 298.19°K. is 59.44 ± 0.10 g.cal./deg./mol.

W. R. A.

536.63

958

Specific heats at low temperatures of titanium and titanium carbide. KELLEY, K. K. *Industr. Engng Chem.*, 36, pp. 865-866, Sept., 1944.

536.63 : 536.75

959

The specific heats at low temperatures of nitrates of magnesium, calcium, barium, and aluminium. SHOMATE, C. H., AND KELLEY, K. K. *J. Amer. Chem. Soc.*, 66, pp. 1490-1492, Sept., 1944.—Values of C_p were measured from 52° to 298°K. for $\text{Mg}(\text{NO}_3)_2$, $\text{Ca}(\text{NO}_3)_2$, $\text{Ba}(\text{NO}_3)_2$, and $\text{Al}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$. $\text{Ca}(\text{NO}_3)_2$ has two anomalies at 88.5° and 287.8°K. The respective molal entropies are: 39.2 ± 0.5 ; 46.2 ± 0.7 ; 51.1 ± 0.3 ; 111.8 ± 1.9 g.cal./deg./mol. at 298.16°K. Derived free energies of formation from the elements at 298.16°K. are: -140 620 $\pm$ 340; -177 360 $\pm$ 420; -189 940 $\pm$ 500; -526 230 $\pm$ 730 g.cal./mol.

W. R. A.

536.63 : 536.75

960

Ferrous and magnesium chromites. Specific heats at low temperatures. SHOMATE, C. H. *Industr. Engng Chem.*, 36, pp. 910-911, Oct., 1944.—Ferrous chromite

has two anomalies in its sp.ht. curve, one peak at 75° and the other at 135°K. The following molal entropies at 298.16°K. were computed: ferrous chromite, 34.9 ± 0.4 E.U.; magnesium chromite, 25.3 ± 0.2 E.U.

536.63 : 536.75

961

High-temperature heat contents of ferrous and magnesium chromites. NAYLOR, B. F. *Industr. Engng Chem.*, 36, pp. 933-934, Oct., 1944.—A tabular summarizes the heat contents and entropies above 25°C. of these substances at 100° intervals; the data are also adequately represented by equations.

536.633.3 : 533.75 see Abstr. 888

536.65 : 536.7

962

Thermodynamic properties of aqueous salt solutions. HUNTER, J. B., AND BLISS, H. *Industr. Engng Chem.*, 36, pp. 945-953, Oct., 1944.—The gas current method for measuring latent heats of vaporization of water from aq. salt solutions is described, together with the equipment for experimental work. The thermodynamic analysis shows that heats of dilution, partial molal free energy, partial molal entropy, and v.p. as well as lat.ht can be computed from the data obtained. Aq. solutions of KNO_3 , CaCl_2 , and KCNS have been studied at 30°C.

536.658 : 532.696 : 531.724 : 541.183.5 see Abstr. 1118

536.658 : 541.183.5 see Abstr. 1119

536.658 : 541.183.56 see Abstr. 1120

536.662

963

The heats of combustion of some substituted eicosanes, heneicosanes, and docosanes. KNOWLTON, J. W., AND HUFFMAN, H. M. *J. Amer. Chem. Soc.*, 66, pp. 1492-1494, Sept., 1944.—The isothermal heats of combustion at 25° were determined for 3- and 9-phenyleicosane, 3- and 9-cyclohexyleicosane, 11-phenyl-, 11-cyclopentyl-, 11-cyclohexyl-, and 11-n-decyl-heneicosane, and 5-*n*- and 11-*n*-butyldocosane. From these data heats of formation are calculated.

W. R. A.

536.662

964

Heats of combustion of eight normal paraffin hydrocarbons in the liquid state. PROSEN, E. J., AND ROSSINI, F. D. *J. Res. Nat. Bur. Stand., Wash.*, 33, pp. 355-372, Oct., 1944.—The heats of combustion were measured with a bomb calorimeter. The samples were of known high purity, were inclosed in thin glass bulbs and placed in a Pt cup in the calorimetric bomb with purified oxygen at a pressure of 30 atm., and were ignited electrically with a wire fuse. The amount of reaction in each experiment was determined from the amount of CO_2 formed by the combustion. Tests were made for the presence of CO and other products of incomplete combustion. The calorimeter system was calibrated with electrical energy. The following values were found, at 25°C. and const. pressure, in kJ/mole: *n*-pentane, $3\,508.56 \pm 0.77$; *n*-hexane, $4\,162.34 \pm 0.83$; *n*-heptane, $4\,816.35 \pm 0.87$; *n*-octane, $5\,469.82 \pm 1.05$; *n*-nonane, $6\,123.90 \pm 1.12$; *n*-decane, $6\,777.47 \pm 1.52$; *n*-dodecane, $8\,085.20 \pm 1.65$; *n*-hexadecane, $10\,699.1 \pm 2.8$.

536.664 : 541.127.1 see Abstr. 1067